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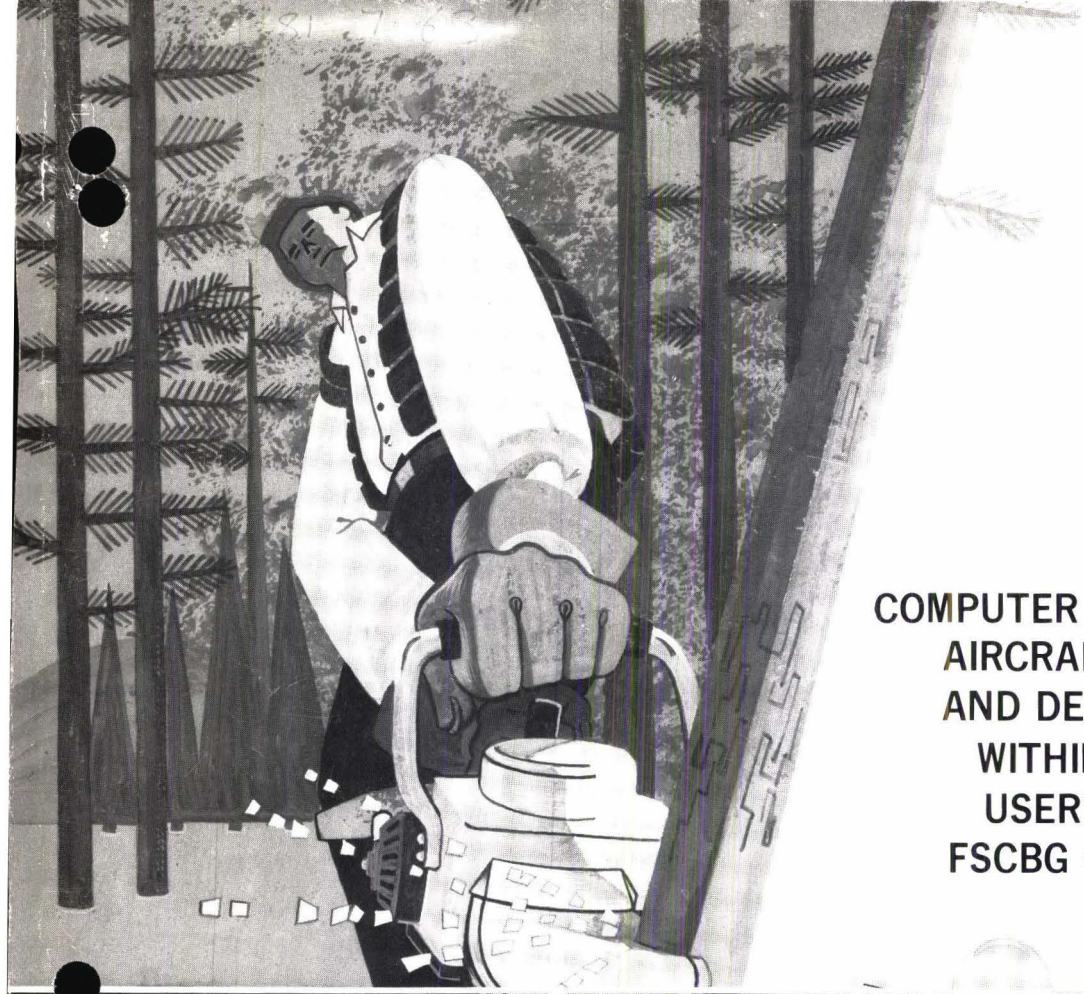
COMPUTER MODELS FOR PREDICTING AIRCRAFT SPRAY DISPERSION AND DEPOSITION ABOVE AND WITHIN FOREST CANOPIES: USER'S MANUAL FOR THE FSCBG COMPUTER PROGRAM

FOREST SERVICE MANUSCRIPT

REGULATIONS



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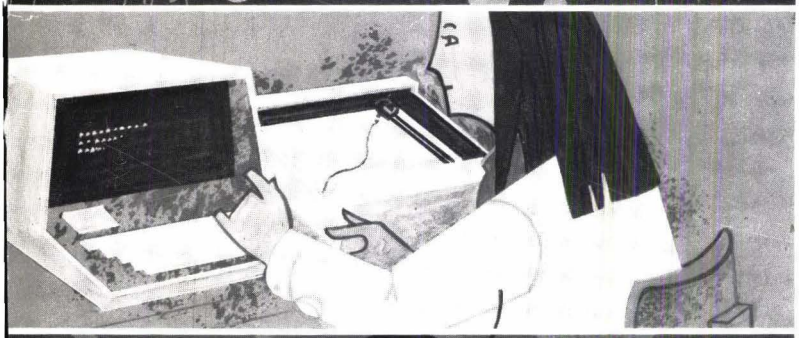

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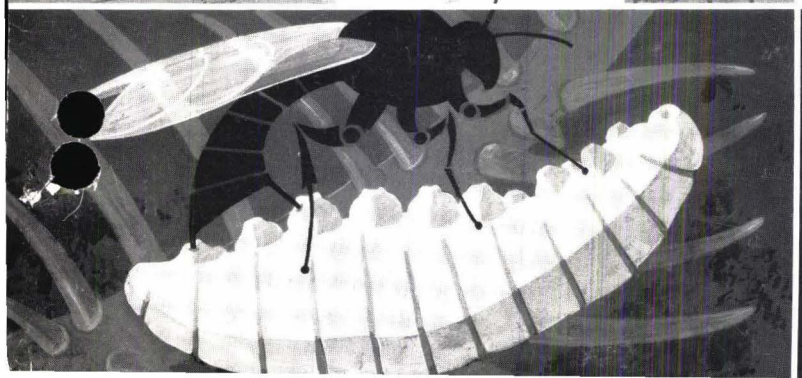

TABLE OF CONTENTS

Section	Title	Page
1	ABSTRACT	1
1	INTRODUCTION	2
	1.1 Background	2
	1.2 Purpose	3
	1.3 General Description of the FSCBG Computer Program	4
	1.4 Report Contents	6
2		
2	DESCRIPTION OF THE FSCBG MODELS AND MODEL INPUT REQUIREMENTS	7
	2.1 Spray Dispersion Models	7
	2.2 Evaporation Model	19
	2.3 Canopy Penetration Model	25
	2.4 Aircraft Wake Model	34
	2.5 Adjustments of Deposition Calculations for Evaporation	38
3	USERS INSTRUCTIONS FOR THE FSCBG COMPUTER PROGRAM	43
	3.1 Summary of Program Models Options, Data Requirements and Output	43
	3.2 User's Instructions	83
4	FSCBG EXAMPLE PROBLEM	120
	4.1 FSCBG Example Problem Description	120
	4.2 FSCBG Example Problem Input Data	126
	4.3 FSCBG Example Problem Output	134
5	FSCBG PROGRAM LISTING	154
	LITERATURE CITED	267
	ACKNOWLEDGEMENTS	270

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COMPUTER MODELS FOR PREDICTING AIRCRAFT SPRAY DISPERSION AND DEPOSITION ABOVE AND WITHIN FOREST CANOPIES: USER'S MANUAL FOR THE FSCBG COMPUTER PROGRAM[1]

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ABSTRACT

The FSCBG computer program described in this report combines and implements mathematical models for aircraft wake effects, line-source dispersion, drop evaporation and canopy penetration. The computer program is designed to account for the atmospheric dispersion, transport and deposition of all aerial spray material from the time of release until all spray material is either deposited or, in the case of spray drift beyond a target area, spray concentration and deposition levels are insignificant. Specific calculations made by the computer program include spray concentrations and dosages above forest canopies as well as the spray deposition within and below forest canopies resulting from aerial spray releases made along single or multiple flight paths. Important applications of the computer program are the optimization of spray program design and operation with respect to the selection of aircraft spray systems, flight altitudes, swath widths, spray rates, and scheduling of spray operations; evaluation and analysis of field measurements of spray deposition; and, assessments of the environmental impact or hazard posed by aerial spray operations.

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[1] Prepared for USDA-Forest Service, Forest Insect and Disease Management Application Group, Davis, CA under Contract No. 53-91S8-9-6127; John W. Barry, USDA-Forest Service, Project Officer.

[2] H. E. Cramer Company, Inc., Post Office Box 8049, Salt Lake City, UT 84108.

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SECTION 1
INTRODUCTION

1.1 BACKGROUND

The USDA Forest Service (USFS) uses aerial spray applications to prevent and suppress tree damage due to pest infestations. As part of an extensive program to develop and evaluate pest management systems, the USFS is interested in achieving a complete understanding of the behavior of spray material from the time spray is released from the aircraft until it has been deposited or, in the case of spray drift, dissipated to concentration/dosage levels that are environmentally insignificant. Because mathematical spray dispersion models are useful in determining interactions of the many factors affecting spray operations, the USFS has supported the application and development of these models over the last decade. Simplified aerial line source models developed for the US Army were applied (GCA Corporation, 1971; H. E. Cramer Company, 1973) early in the decade to determine optimum swath widths and application rates for use in pilot tests of insecticides under consideration at that time for control applications in western forests. The implications of these early efforts in the use of mathematical models to improve the planning, conduct and analysis of spray programs were reviewed in a paper presented at the USFS Workshop for Aerial Application of Insecticides Against Forest Defoliators, held in Missoula, Montana, 23-29 April 1974 (Dumbauld, Cramer and Barry, 1975). The H. E. Cramer Company (Dumbauld and Bjorklund, 1977) used aerial spray dispersion models to assist the State of Maine Bureau of Forestry in determining offset distances required for various aircraft to ensure that drift from spray blocks in the Maine 1977 spray program posed no environmental hazard to exclusion areas (waterways, homes, etc.) in the vicinity of the spray blocks. Under the sponsorship of the USDA Expanded Douglas-fir Tussock Moth Research and Development Program, work began in early 1977 on the development of a technical data base for use in applying mathematical dispersion models to USFS spray projects and the refinement

and adaptation of existing models to predict spray behavior above and within forest canopies. This work (Dumbauld, Rafferty and Bjorklund, 1977) resulted in the development of the CBG computerized spray dispersion model and the comparison of model predictions with measurements made during selected USFS spray programs. The CBG computer program has recently been applied in the development of optimum swath widths, application rates, and aircraft altitudes for the conduct of a pilot project in the Withlacoochee State Seed Orchard Project (Rafferty and Dumbauld, 1980) and is currently being used in evaluating the results of the project. The USFS (Dumbauld, Bowman and Rafferty, 1980) has also sponsored the use of the CBG model to determine optimum swath widths and spray altitudes for specific spray aircraft planned for use in the Maine 1980 Spray Program. A general discussion of spray behavior in and above canopies can be found in the report describing research funded by the USDA Expanded Douglas Fir Tussock Moth Research and Development Program (Brookes, Stark and Campbell, 1978).

The CBG computer based model is comprised of two major parts. The first part simulates the deposition of spray drops at the top of a forest canopy. The second part, which is based on a model developed by Grim and Barry (1975), simulates the penetration of spray drops into the forest canopy. This report describes a new computer program developed under the sponsorship of Methods Application Group, USFS (MAG) to extend the usefulness of the modeling concepts and applicability of the CBG computer based model.

1.2 PURPOSE

The primary purpose for the development of the FSCBG computer program described in this report was to extend the CBG computer based model to include the effects of spray drop evaporation on the spray deposition patterns and drift concentration/dosage levels. Because the program changes for including evaporation effects were extensive, the decision was

made to construct the new program in a modular fashion to ensure that further updates in the various calculation procedures could be more easily accomplished. Also, many calculations for deriving input parameters, such as the gravitational settling velocity of drops, are performed automatically, on user option, by the new program.

1.3 GENERAL DESCRIPTION OF THE FSCBG COMPUTER PROGRAM

The FSCBG computer program implements an aircraft wake-settling velocity model, line-source dispersion models, a drop evaporation model and a canopy penetration model to calculate the concentration, dosage and deposition above and below a forest canopy downwind from multiple aircraft spray lines or swaths. The program is written in FORTRAN IV and is designed for implementation on a UNIVAC 1108 computer, although the program is easily adapted to other computer systems. The computer program requires 32K words of core storage. Figure 1-1 is a schematic diagram showing the major components of the FSCBG program. As indicated in the figure, program control parameters, as well as source and meteorological data are input to the program via card image. The input requirements of the program are discussed in detail in Section 3. Definitions of the meteorological and source inputs and their relationships to the various program models are given in Section 2. Figure 1-1 shows that the user may select a number of model options. The Above Canopy and Below Canopy Evaporation Model option allow the user to specify whether or not drop evaporation is to be included in a calculation of concentration, dosage and deposition. If the user selects a drop evaporation option, the program automatically calculates the change in drop diameter with time, using a polynomial expression fitted either to empirical data or theoretical calculations. The Wake-Settling Velocity Model option permits the user either to input the aircraft wake-settling velocity directly or to input the aircraft weight, wing span and ground speed which the program uses to calculate the aircraft wake-settling velocity.

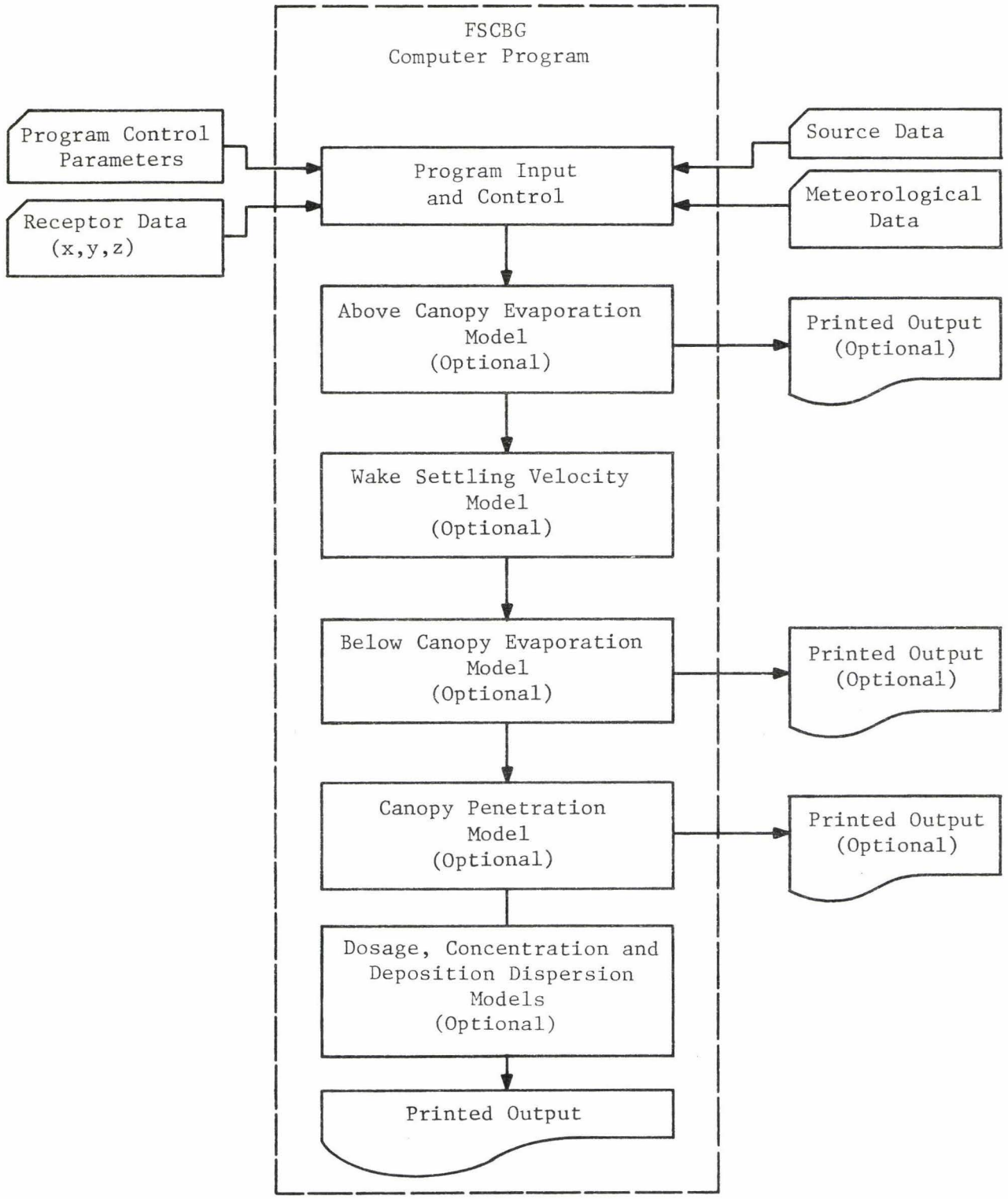

FIGURE 1-1. Schematic diagram of the FSCBG computer program.

The Canopy Penetration Model option permits the user to calculate the fraction of material presented at the canopy top, penetrating the canopy and reaching up to 10 levels within and below the canopy, including the ground. Finally the Dosage and Concentration Dispersion models permit the user to calculate dosage, concentration and area coverage of user specified dosage and concentration levels above the canopy and below the height of elevated inversions. The Deposition Dispersion Model allows the user to calculate deposition and deposition area-coverage at any height below the height of elevated inversions, including heights below the canopy top when the model is used in conjunction with the Canopy Penetration Model. In its present configuration, the FSCBG computer program can calculate the dosage, concentration and deposition at a maximum of 737 receptor coordinates downwind from a maximum of 100 line sources.

1.4 REPORT CONTENTS

Section 2 of this report describes the aircraft wake model, dispersion models, evaporation model, canopy penetration model, as well as the meteorological and source inputs required by the models. User's instructions for the FSCBG program are contained in Section 3. An example problem illustrating use of the FSCBG program is given in Section 4. Finally, a FORTRAN listing of the FSCBG program is contained in Section 5.

SECTION 2

DESCRIPTION OF THE FSCBG MODELS AND MODEL INPUT REQUIREMENTS

2.1 SPRAY DISPERSION MODELS

The spray dispersion models incorporated within the FSCBG computer program are similar to the aircraft spray models described by Dumbauld, Rafferty and Cramer (1976). These models were developed previously for the U. S. Army Dugway Proving Ground and are based on the generalized diffusion model concepts described by Cramer, et al. (1972). The models were also used in the CBG computer program and the mathematical basis for the models is given in Appendix B of the report by Dumbauld, Rafferty and Bjorklund (1977). In this report we describe the models used in the FSCBG program to calculate peak concentration, dosage and deposition downwind from nearly-instantaneous elevated line sources oriented at an arbitrary angle with respect to the mean wind direction. In the models, the axis of the spray cloud is assumed to be inclined from the horizontal plane by an angle that is proportional to $(V_j/\bar{u})$, where V_j is the gravitational settling velocity for the j^{th} drop-size category and $\bar{u}$ is the mean cloud transport speed. When evaporation is negligible, this inclination angle is invariant with distance from the line source. For evaporating drops, the angle changes with distance from the source because V_j depends on the drop size. It is assumed that drops dispersed upwards by turbulence are totally reflected downwards at the top of the surface mixing layer, but the fraction of drops reflected at the ground is a variable input parameter for each j^{th} category. The models use the Cartesian coordinate system shown in Figure 2-1 for a line source of length L at a height H_j' and a calculation point at $R(\varepsilon, \delta, z)$.

Dosage Models. The dosage (mass × time/unit volume) above the canopy is the sum of contributions from drops in the dispersing cloud

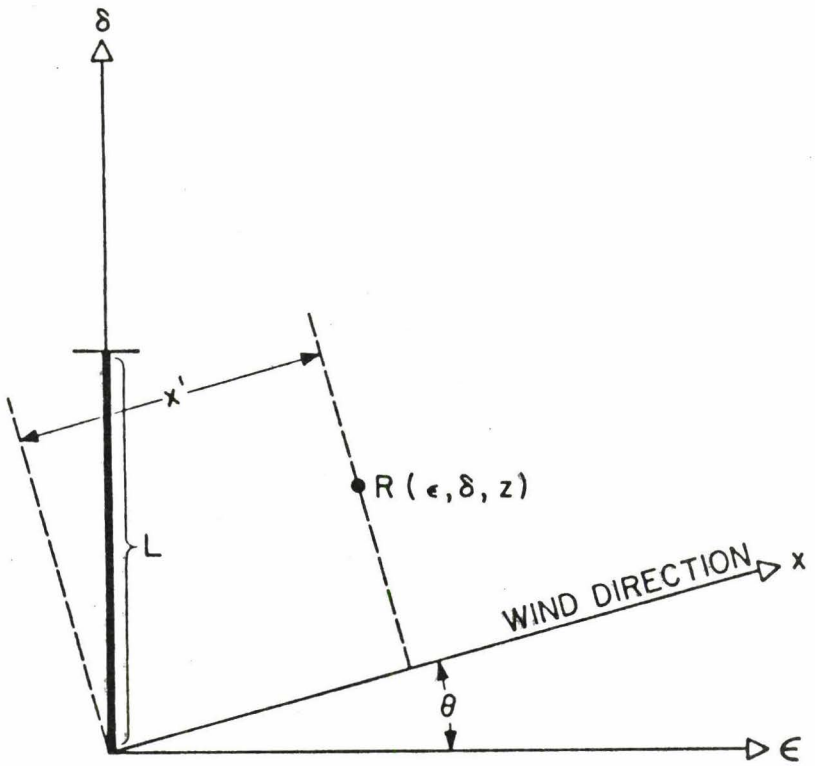

FIGURE 2-1. Schematic plan view showing the line source geometry with respect to a calculation point at R(ε, δ, z) for a wind direction θ.

and from vapor produced by drop evaporation. The above canopy dosage for the contribution from drops is given by the expression

$$D_L = \frac{S}{k\,\sigma_A'\,\sin\theta\,\bar{u}} \sum_{j=1}^{J} f_j \left\{ \sum_{i=0}^{\infty} \left[\gamma_j^{\,i} \left(\frac{\pi}{2Y}\right)^{1/2} \left\{ \exp\left(\frac{O^2}{4Y}\right) - P \right\} \right.\right.$$

$$\left\{ \operatorname{erf}\left(Y^{1/2} \left(\frac{k}{a} + \frac{O}{2Y} \right) \right) - \operatorname{erf}\left(Y^{1/2} \left(\frac{k}{b} + \frac{O}{2Y} \right) \right) \right\}$$

$$\left. + \gamma_j^{\,i+1} \left(\frac{\pi}{2Z}\right)^{1/2} \left\{ \exp\left(\frac{R^2}{4Z} - P\right) \right\} \left\{ \operatorname{erf}\left(Z^{1/2} \left(\frac{k}{a} + \frac{R}{2Z} \right) \right) - \operatorname{erf}\left(Z^{1/2} \left(\frac{k}{b} + \frac{R}{2Z} \right) \right) \right\} \right] \quad (2\text{-}1)$$

$$+ \sum_{i=1}^{\infty} \left[\gamma_j^{\,i} \left(\frac{\pi}{2T}\right)^{1/2} \left\{ \exp\left(\frac{U^2}{4T} - P\right) \right\} \left\{ \operatorname{erf}\left(T^{1/2} \left(\frac{k}{a} + \frac{U}{2T} \right) \right) - \operatorname{erf}\left(T^{1/2} \left(\frac{k}{a} + \frac{U}{2T} \right) \right) \right\} \right.$$

$$\left. \left. + \gamma_j^{\,i-1} \left(\frac{\pi}{2W}\right)^{1/2} \left\{ \exp\left(\frac{X}{4W} - P\right) \right\} \left\{ \operatorname{erf}\left(W^{1/2} \left(\frac{k}{a} + \frac{X}{2W} \right) \right) - \operatorname{erf}\left(W^{1/2} \left(\frac{k}{b} + \frac{X}{2W} \right) \right) \right\} \right] \right\}$$

where

$$S = Qk/2\pi L \quad (2\text{-}2)$$

$$Y = \frac{1}{k^2} \left[n - \frac{\delta}{\cos\theta} \right]^2 + \left[C + z \right]^2 \quad (2\text{-}3)$$

$$O = \frac{2^{1/2}}{\sigma_A' k} \left[\frac{k^2 V_j}{\bar{u}} \left(C + z \right) - \left(n - \frac{\delta}{\cos\theta} \right) \cot\theta \right] \quad (2\text{-}4)$$

$$P = \left[\frac{kV_j}{2^{1/2}\sigma_A' \bar{u}}\right]^2 + \left[\frac{\cot\theta}{2^{1/2}\sigma_A'}\right]^2 \qquad (2\text{-}5)$$

$$Z = \frac{1}{k^2}\left[n - \frac{\delta}{\cos\theta}\right]^2 + \left[D + z\right]^2 \qquad (2\text{-}6)$$

$$R = -\frac{2^{1/2}}{\sigma_A' k}\left[\frac{k^2 V_j}{\bar{u}}\left(D + z\right) + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \qquad (2\text{-}7)$$

$$T = \frac{1}{k^2}\left[n - \frac{\delta}{\cos\theta}\right]^2 + \left[D - z\right]^2 \qquad (2\text{-}8)$$

$$U = -\frac{2^{1/2}}{\sigma_A' k}\left[\frac{k^2 V_j}{\bar{u}}\left(D - z\right) + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \qquad (2\text{-}9)$$

$$W = \frac{1}{k^2}\left[n - \frac{\delta}{\cos\theta}\right]^2 + \left[C - z\right]^2 \qquad (2\text{-}10)$$

$$X = \frac{2^{1/2}}{\sigma_A' k}\left[\frac{k^2 V_j}{\bar{u}}\left(C - z\right) - \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \qquad (2\text{-}11)$$

$$C = 2iH_m - H_j' - \left(V_j x_V/\bar{u}\right) \qquad (2\text{-}12)$$

$$D = 2iH_m + H_j' + \left(V_j x_V/\bar{u}\right) \qquad (2\text{-}13)$$

$$a = 2^{1/2}\,\sigma'_A\left(x' + x_V - \ell\,\sin\theta\right) \tag{2-14}$$

$$b = 2^{1/2}\,\sigma'_A\left(x' + x_V\right)\Big) \tag{2-15}$$

$$n = \left(x' + x_V\right)\cot\theta + x'\tan\theta = \left(\varepsilon/\sin\theta\right) + \left(\delta/\cos\theta\right) + x_V\cot\theta \tag{2-16}$$

$$x' = \left(\varepsilon + \delta\,\tan\theta\right)\,\cos\theta = \varepsilon\,\cos\theta + \delta\,\sin\theta \tag{2-17}$$

x_V = virtual distance

$$= \frac{k\sigma_o}{\sigma'_A} - x_R = \frac{\sigma_o}{\sigma'_E} - x_R \tag{2-18}$$

ℓ = effective line length

$$= \begin{cases} \delta + \varepsilon\,\cot\theta \;; & \delta + \varepsilon\,\cot\theta \leq L \\ L \;; & \delta + \varepsilon\,\cot\theta > L \end{cases} \tag{2-19}$$

The following parameters used in the preceding equations are based on meteorological measurements or inferred from meteorological measurements:

σ'_A = standard deviation of the wind azimuth angle in radians

k = constant relating σ'_A and σ'_E

$$= \sigma'_A/\sigma'_E \qquad (2\text{-}20)$$

σ'_E = standard deviation of the wind elevation angle in radians

H_m = depth of the surface mixing layer below a capping inversion

$\bar{u}$ = mean transport wind speed above the canopy

θ = angle between a line perpendicular to the line source and the mean wind direction (see Figure 2-1)

$\Delta\bar{u}$ = vertical wind-speed shear (see Equation (2-30))

The following parameters are source inputs required for use in the model:

Q = total source strength emitted along the length L of the line source

H = aircraft flight altitude above the ground

V_j = gravitational settling velocity for the median drop by mass in the j^{th} drop-size category

f_j = fraction of the total source strength in the j^{th} drop-size category

γ_j = reflection coefficient for the median drop by mass in the j^{th} drop-size category

σ_o = standard deviation of the cloud distribution at the distance x_R

L = length of the line source

As noted above, the vapor emitted from evaporating drops also contributes to the total dosage above the canopy. In the program construct, the evaporation model determines the mass of vapor emitted in Δh height units along the cloud axis as it descends to the canopy. The distance downwind from the line source where the vapor is emitted is given by $\bar{u}t$ where t is the time from the evaporation model when the cloud axis passes through the midpoint of the height interval Δh. The source dimension of the vapor cloud emitted over the Δh height interval is

$$\sigma_o = \frac{\Delta h}{\sqrt{12}} \qquad (2\text{-}21)$$

under the assumption that the vapor is rectangularly distributed at the point of emission. The vapor dosage is then calculated from Equation (2-1) with V_j set equal to zero, γ_j set to equal unity, and x_R set equal to $\bar{u}t$. Finally, the total dosage at the calculations point is determined in the program by summing the contributions from the drops and vapor clouds.

As inspection of Equation (2-1) and the definitions of the parameters appearing in Equation (2-1) show, the model cannot be used when the wind direction is exactly parallel to the line source (θ=90 degrees) or when the wind direction is exactly perpendicular to the line source (θ=0 degrees). For the case when θ=90 degrees, the program uses the

exact solution by making the following substitutions in Equation (2-1) through (2-19):

$$\left.\begin{aligned} \cot\theta &= 0 \\ \left(n - \frac{\delta}{\cos\theta}\right) &= y \\ \sin\theta &= 1 \end{aligned}\right\} \tag{2-22}$$

and defining x' as the downwind distance from the upwind edge of the line source and y as the crosswind distance from the line source. For the case when θ=0 degrees, the program also uses the exact solution

$$D_L = \frac{Q}{2\pi\ \sigma_y\ \sigma_z\ \bar{u}\ L}\ \{\text{Vertical Term}\}\ \{\text{Lateral Term}\} \tag{2-23}$$

The Vertical Term is

$$f_j\left\{\sum_{i=0}^{\infty}\left[\gamma_j^i\ \exp\left[-\frac{1}{2}\left(\frac{2iH_m - H_j' + z + V_j x/\bar{u}}{\sigma_z}\right)^2\right] + \gamma_j^{i+1}\ \exp\left[-\frac{1}{2}\left(\frac{2iH_m + H_j' + z - V_j x/\bar{u}}{\sigma_z}\right)^2\right]\right]\right. \tag{2-24}$$

$$\left. + \sum_{i=1}^{\infty}\left[\gamma_j^i\ \exp\left[-\frac{1}{2}\left(\frac{2iH_m + H_j' - z - V_j x/\bar{u}}{\sigma_z}\right)^2\right] + \gamma_j^{i-1}\ \exp\left[-\frac{1}{2}\left(\frac{2iH_m - H_j' - z + V_j x/\bar{u}}{\sigma_z}\right)^2\right]\right]\right\}$$

where, for convenience, the quantity 0^o is defined to be equal to unity.

exact solution by making the following substitutions in Equation (2-1) through (2-19):

$$\left.\begin{aligned} \cot\theta &= 0 \\ \left(n - \frac{\delta}{\cos\theta}\right) &= y \\ \sin\theta &= 1 \end{aligned}\right\} \qquad (2\text{-}22)$$

and defining x' as the downwind distance from the upwind edge of the line source and y as the crosswind distance from the line source. For the case when θ=0 degrees, the program also uses the exact solution

$$D_L = \frac{Q}{\sqrt{2\pi}\,\sigma_z\,\bar{u}\,L} \quad \{\text{Vertical Term}\}\,\{\text{Lateral Term}\} \qquad (2\text{-}23)$$

The Vertical Term is

$$f_j \left\{ \sum_{i=0}^{\infty} \left[\gamma_j^i \exp\left[-\frac{1}{2}\left(\frac{2iH_m - H_j' + z + V_j x/\bar{u}}{\sigma_z} \right)^2 \right] + \gamma_j^{i+1} \exp\left[-\frac{1}{2}\left(\frac{2iH_m + H_j' + z - V_j x/\bar{u}}{\sigma_z} \right)^2 \right] \right] \right. \qquad (2\text{-}24)$$

$$\left. + \sum_{i=1}^{\infty} \left[\gamma_j^i \exp\left[-\frac{1}{2}\left(\frac{2iH_m + H_j' - z - V_j x/\bar{u}}{\sigma_z} \right)^2 \right] + \gamma_j^{i-1} \exp\left[-\frac{1}{2}\left(\frac{2iH_m - H_j' - z + V_j x/\bar{u}}{\sigma_z} \right)^2 \right] \right] \right\}$$

where, for convenience, the quantity 0^0 is defined to be equal to unity.

The Lateral Term is

$$\frac{1}{2}\left[\text{erf}\left(\frac{L/2 + y}{\sqrt{2}\,\sigma_y}\right) + \text{erf}\left(\frac{L/2 - y}{\sqrt{2}\,\sigma_y}\right)\right] \tag{2-25}$$

In Equation (2-24), x is the downwind distance from the line source and in Equation (2-25), y is the crosswind distance from the center of the line source. In the program, the standard deviation of the crosswind distribution σ_y and of the vertical distribution σ_z are defined by the expressions

$$\sigma_y = \sigma'_A(x) + \sigma_o \tag{2-26}$$

$$\sigma_z = \frac{A'}{k}(x) + \sigma_o \tag{2-27}$$

Peak Concentration Models

The peak concentration (mass per unit volume) which occurs at the calculation point is determined from the expression

$$\chi_{pL} = \frac{D_L\,\bar{u}}{\sqrt{2\pi}\,\sigma_x} \tag{2-28}$$

where σ_x is the standard deviation of the cloud in the alongwind direction defined by

$$\sigma_x = \left[\left(\frac{L\{x\}}{4.3}\right)^2 + \sigma_o^2\right]^{1/2} \tag{2-29}$$

and

$L\{x\}$ = alongwind cloud length

$$= \frac{0.6\,\Delta\bar{u}}{\bar{u}}\left(x' - \frac{L\sin\theta}{2}\right) \qquad (2\text{-}30)$$

$\Delta\bar{u}$ = vertical wind-speed shear in the layer containing the cloud

The use of the peak concentration models requires that the meteorological parameter $\Delta\bar{u}$ be specified in the program input list. Also, it should be noted that the peak concentrations obtained using the FSCBG model are strictly correct only for corsswind releases. Errors made for alongwind releases and releases at an angle to the wind direction decrease at distances beyond the most downwind end of the source.

Deposition Models

The deposition, expressed in units of mass per unit area, at the point (ε, δ, 0) downwind from line sources at an angle θ with the mean wind direction is given by the expression

$$Dep_L = \frac{2S}{\sin\theta}\sum_{j=1}^{J} f_j\,(1\gamma_j)\left\{\frac{B\exp\left(\frac{G^2}{4F} - P\right)}{2F}\left[\exp\left[-\left(F^{1/2}\left(\frac{1}{a} - \frac{G}{2F}\right)\right)^2\right]\right.\right.$$

$$\left.\left. - \exp\left[-\left(F^{1/2}\left(\frac{1}{b} - \frac{G}{2F}\right)\right)^2\right]\right] + \frac{GB\pi^{1/2}\exp\left(\frac{G^2}{4F} - P\right)}{4F^{3/2}}\right. \qquad (2\text{-}31)$$

$$\left.\left[\mathrm{erf}\left(F^{1/2}\left(\frac{1}{b} - \frac{G}{2F}\right)\right) - \mathrm{erf}\left(F^{1/2}\left(\frac{1}{a} - \frac{G}{2F}\right)\right)\right]\right.$$

(Equation (2-31) is continued) ...

$$+ \sum_{i=1}^{\infty} \gamma_j^{i-1} \left\{ \frac{C \exp \frac{J^2}{4I} - P}{2I} \left[\exp \left[-\left(I^{1/2} \left(\frac{1}{a} - \frac{J}{2I} \right) \right)^2 \right] \right. \right.$$

$$\left. - \exp \left[- \left(I^{1/2} \left(\frac{1}{b} - \frac{J}{2I} \right) \right)^2 \right] \right] + \frac{JC\pi^{1/2} \exp \left(\frac{J^2}{4I} - P \right)}{4I^{3/2}}$$

$$\left[\operatorname{erf} \left(I^{1/2} \left(\frac{1}{b} - \frac{J}{2I} \right) \right) - \operatorname{erf} \left(I^{1/2} \left(\frac{1}{a} - \frac{J}{2I} \right) \right) \right] \qquad (2\text{-}31) \text{ (cont.)}$$

$$+ \gamma_j \frac{D \exp \left(\frac{K^2}{4E} - P \right)}{2E} \left[\exp \left[-\left(E^{1/2} \left(\frac{1}{a} - \frac{K}{2E} \right) \right)^2 \right] - \exp \left[-\left(E^{1/2} \left(\frac{1}{b} - \frac{K}{2E} \right) \right)^2 \right] \right]$$

$$\left. + \gamma_j \frac{KD\pi^{1/2} \exp \left(\frac{K^2}{4E} - P \right)}{4E^{3/2}} \left[\operatorname{erf} \left(E^{1/2} \left(\frac{1}{b} - \frac{K}{2E} \right) \right) - \operatorname{erf} \left(E^{1/2} \left(\frac{1}{a} - \frac{K}{2E} \right) \right) \right] \right\} \right\}$$

$$B = H' + \frac{V_j \, x_V}{\bar{u}} \qquad (2\text{-}32)$$

$$G = \frac{2^{1/2}}{\sigma_A'} \left[\frac{V_j B k^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta} \right) \cot\theta \right] \qquad (2\text{-}33)$$

$$F = k^2 B^2 + \left(n - \frac{\delta}{\cos\theta} \right)^2 \qquad (2\text{-}34)$$

$$J = \frac{-2^{1/2}}{\sigma_A'} \left[\frac{V_j C k^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta} \right) \cot\theta \right] \qquad (2\text{-}35)$$

$$- \exp\left[-\left(I^{1/2}\left(\frac{1}{b} - \frac{J}{2I}\right)\right)^2\right]\Bigg] + \frac{JC\pi^{1/2}\exp\left(\frac{J^2}{4I} - P\right)}{4I^{3/2}}$$

$$\left[\operatorname{erf}\left(I^{1/2}\left(\frac{1}{b} - \frac{J}{2I}\right)\right) - \operatorname{erf}\left(I^{1/2}\left(\frac{1}{a} - \frac{J}{2I}\right)\right)\right]$$

(2-31)
(Cont.)

$$+ \gamma_j \frac{D\exp\left(\frac{K^2}{4E} - P\right)}{2E}\left[\exp\left[-\left(E^{1/2}\left(\frac{1}{a} - \frac{K}{2E}\right)\right)^2\right] - \exp\left[-\left(E^{1/2}\left(\frac{1}{b} - \frac{K}{2E}\right)\right)^2\right]\right]$$

$$+ \gamma_j \frac{KD\pi^{1/2}\exp\left(\frac{K^2}{4E} - P\right)}{4E^{3/2}}\left[\operatorname{erf}\left(E^{1/2}\left(\frac{1}{b} - \frac{K}{2E}\right)\right) - \operatorname{erf}\left(E^{1/2}\left(\frac{1}{a} - \frac{K}{2E}\right)\right)\right]\Bigg\}\Bigg\}$$

$$B = H' + \frac{V_j x_V}{\bar{u}} \tag{2-32}$$

$$G = \frac{2^{1/2}}{\sigma'_A}\left[\frac{V_j B k^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \tag{2-33}$$

$$F = k^2 B^2 + \left(n - \frac{\delta}{\cos\theta}\right)^2 \tag{2-34}$$

$$J = \frac{-2^{1/2}}{\sigma'_A}\left[\frac{V_j C k^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \tag{2-35}$$

$$I = k^2C^2 + \left(n - \frac{\delta}{\cos\theta}\right)^2 \tag{2-36}$$

$$K = \frac{2^{1/2}}{\sigma'_A}\left[\frac{V_j Dk^2}{\bar{u}} + \left(n - \frac{\delta}{\cos\theta}\right)\cot\theta\right] \tag{2-37}$$

$$E = k^2d^2 + \left(n - \frac{\delta}{\cos\theta}\right)^2 \tag{2-38}$$

and the remaining parameters, except a and b, are identical to those defined for the dosage model. The definitions of a and b for the dosage model given by Equations (2-14) and (2-15) are reversed in the case of the deposition model, i.e.,

$$a = 2^{1/2}\ \sigma'_A\left(x' + x_V\right) \tag{2-39}$$

$$b = 2^{1/2}\ \sigma'_A\left(x' + x_V - \ell\sin\theta\right) \tag{2-40}$$

The deposition model that applies when the wind direction is exactly parallel to the line source can be obtained from Equations (2-31) through (2-38) using the substitutions defined by Equation (2-22). Deposition for the case when the wind is exactly perpendicular to the line source is given by the expression

$$\text{Deposition} = \sum_{j=1}^{J} \frac{f_j\ Q(1-\gamma_j)}{2\pi\ \sigma_y\ \sigma_z(x+x_V)}\ \{\text{Vertical Term}\}\ \{\text{Lateral Term}\} \tag{2-41}$$

where the Vertical Term is

$$\left\{\left[H_j' + \frac{V_j x_V}{\bar{u}}\right]\left[\exp\left(-\frac{1}{2}\left(\frac{H_j' - V_j\, x/\bar{u}}{\sigma_z}\right)^2\right)\right]\right\}$$

$$+\sum_{i=1}^{\infty} \gamma_j^{\,i-1}\left\{\left[2i\,H_m - H_j' - \frac{V_j x_V}{\bar{u}}\right]\left[\exp\left(-\frac{1}{2}\left(\frac{2i\,H_m - H_j' + V_j\, x/\bar{u}}{\sigma_z}\right)^2\right)\right]\right. \quad (2\text{-}42)$$

$$\left. + \gamma_j\left[2iH_m + H_j' + \frac{V_j x_V}{\bar{u}}\right]\left[\exp\left(-\frac{1}{2}\left(\frac{2i\,H_m - H_j' + V_j\, x/\bar{u}}{\sigma_z}\right)^2\right)\right]\right\}$$

As before, 0^o is defined to be equal to unity and x is the downwind distance from the source. The Lateral Term in Equation (2-41) is defined by Equation (2-25) where y is the crosswind distance from the center of the line source and σ_y and σ_z are defined, respectively, by Equations (2-26) and (2-27). (2-27).

2.2 EVAPORATION MODEL

The FSCBG computer program has a number of options allowing the user to account for the effects of the evaporation of drops in the calculation of dosage, concentration and deposition. The first step in the calculation of evaporation effects is the specification of the time-rate change of the drop diameter for the initial j drop-size categories. The program user has the option of selecting an automated procedure for the theoretical calculation of the time-rate change in drop diameter, or of supplying values of the constants A, B and C in the quadratic equation

$$D_j = A_j + B_j t + C_j t^2 \quad (2\text{-}43)$$

specifying the change of drop diameter with time t after release.

The theoretical calculation of the time-rate change of drop diameter in the FSCBG program is based on the expression

$$D_{f,j} = D_{i,j} + \frac{dD}{dt} \Delta t \qquad (2\text{-}44)$$

where

$D_{f,j}$ = final diameter of the median drop in the j^{th} drop-size category after the time increment Δt

$D_{i,j}$ = initial diameter of the median drop in the j^{th} drop-size category

Frössling (see Fuchs, 1959, p. 44) defines the change in diameter of water drops due to evaporation by

$$\frac{d\,D_j}{dt} = \frac{(4x10^8)\ M_\ell\ D_v\ \rho_A\ (e_s - e_\infty)}{M_m\ D_j\ \rho_\ell\ (P_A - e_s)}\ \bar{f}_v \qquad (2\text{-}45)$$

where

M_ℓ = molecular weight of evaporating vapor from the drop (g mol^{-1})

M_m = mean molecular weight of the resulting vapor-air mixture in the transfer path which is approximated by that of air (M_A) in the FSCBG program (g mol^{-1})

D_v = molecular diffusivity of the evaporating vapor in air at the drop temperature ($cm^2\ s^{-1}$)

D_j = drop diameter (μm)

ρ_A = air density (g cm^{-3})

ρ_ℓ = density of the liquid drop (g cm^{-3})

e_s = partial pressure of the evaporating vapor at the drop surface (mb)

e_∞ = partial pressure of the evaporating vapor at an infinite distance from the drop (mb)

P_A = air pressure (mb)

$\bar{f}_v$ = ventilation factor (dimensionless)

The air density in the model is calculated from the relationship

$$\rho_a = \frac{P_A M_A}{R^* T_V} \left(10^{-4}\right) \tag{2-46}$$

where R* is the universal gas constant (8.31432 j mole^{-1} $^oK^{-1}$) and T_V is given in terms of the mixing ratio r_∞. According to Beard and Pruppacher (1971),

$$T_V = T_A \left(1 + \frac{r_\infty}{0.62197}\right) \Big/ (1+r_\infty) \tag{2-47}$$

where

T_A = air temperature (^oK)

$$r_\infty = 0.62197\ e_\infty/(P_A - e_\infty) \tag{2-48}$$

The diffusivity D_v of the vapor into air at the temperature of the surface of the drop T_r depends on the liquid being considered. For water drops, the FSCBG program uses the expression (Pruppacher and Rasmussen, 1979)

$$D_v = 0.211 \left[\frac{T_r}{T_o}\right]^{1.94} \left[\frac{P_o}{P_A}\right] \tag{2-49}$$

where T_o is 273.16 ^oK, P_o is 1013.25 mb and T_r is determined from the relation

$$T_r = T_A - \frac{L\, D_v\, M_\ell\, (e_s - e_\infty)}{k\, R^*\, T_f} \tag{2-50}$$

where

L = latent heat of vaporization (cal g^{-1})

$$= 597.3 \left[\frac{T_o}{T_r} \right]^{\alpha} \tag{2-51}$$

$$\alpha = 0.107 + 3.67 \times 10^{-4}\, T_r \tag{2-52}$$

k = thermal conductivity (cal $cm^{-1}\ s^{-1}\ {}^oK^{-1}$) (2-53)

$$= k_d \left[1 - (1.17 - 1.02\, k_v/k_d)(e_\infty/P_A) \right] \tag{2-53}$$

$$k_d = 10^{-5} \left[5.69 - 0.017\, (T_r - T_o) \right] \tag{2-54}$$

$$k_v = 10^{-5} \left[3.78 - 0.020\, (T_r - T_o) \right] \tag{2-55}$$

$$T_f = (T_r + T_A)/2 \tag{2-56}$$

The partial pressure e_s is defined by the expression

$$e_s = \beta \left[\frac{575.0466 + 31.82291\, T_i + 1.296028\, T_i^{\,2}}{93.51611 - T_i} \right] \tag{2-57}$$

where

$$T_i = T_r - T_o \tag{2-58}$$

and

$$\beta = 1 \tag{2-59}$$

The vapor pressure at e_∞ is also obtained from Equation (2-57) when T_r is replaced by T_A in Equation (2-58) and β is replaced by (RH/100), where RH is the relative humidity in percent. To find the drop temperature, vapor pressure at the drop surface and diffusivity, Equations (2-49) through (2-57) are solved by iteration in the FSCBG program.

The ventilation factor $\bar{f}_v$ for water is given by (Pruppacher and Rasmussen, 1979)

$$\bar{f}_v = \begin{cases} 0.78 + 0.308\ Sc^{1/3}\ Re^{1/2} & 1.4 < Sc^{1/3}\ Re^{1/2} \leq 51.4 \\ 1.00 + 1.108\ Sc^{1/3}\ Re^{1/2} & 0 \leq Sc^{1/3}\ Re^{1/2} \leq 1.4 \end{cases} \tag{2-60}$$

where

Re = Reynolds number

$$= \frac{V_j\ D_j\ \rho_A}{\mu_A}\ \left(10^{-4}\right) \tag{2-61}$$

Sc = Schmidt number

$$= \frac{\mu_A}{D_v\ \rho_A} \tag{2-62}$$

μ_A = absolute viscosity of air (g cm^{-1} s^{-1})

$$= \frac{(7.6342 \times 10^{-2})}{(T_A + 296.16)} \left(\frac{T_A}{296.16}\right)^{3/2} \tag{2-63}$$

The user can, on option, ask the FSCBG program to theoretically determine the time-rate change of drop diameter for non-water drops.

However, additional information is required by the program. When this option is selected, the drop temperature and vapor pressure at the drop are automatically calculated from the expression (Picot, 1979)

$$A \exp\left(B - C/T_r\right) - e_s = \left(\frac{k}{C_f D_v L}\right)\left(T_A - T_r\right)\left[P_A - A \exp\left(B - C/T_r\right)\right] \quad (2\text{-}64)$$

where

$A = P_o/760$

C_f = molal concentration of the liquid (mol cm^{-3})

k = thermal conductivity of the gas mixture surrounding the drops at the drop surface temperature

B, C = constants obtained from tables expressing variations of vapor pressure with temperature (see, for example, page D-140, Handbook of Chemistry, 58th Edition, published by Chemical Rubber Co.)

Values of k, D_v and L for non-water drops must also be specified by the program user. The value of e_∞ for non-water drops can probably be set equal to zero. When the parameters required by Equation (2-64) have been specified, the program uses Newton's iteration procedures to determine the drop temperature and vapor pressure and the time-rate change of diameter, using the following expression (Fuchs, 1959) for the ventilation coefficient

$$\bar{f}_v = \frac{1}{2} Sh \quad (2\text{-}65)$$

where

Sh = Sherwood number

$$= 2\left(1 + \alpha\ Sc^{1/3}\ Re^{1/2}\right) \quad (2\text{-}66)$$

and α is set equal to 0.3 in the FSCBG program as suggested by Picot (1979).

However, additional information is required by the program. When this option is selected, the drop temperature and vapor pressure at the drop are automatically calculated from the expression (Picot, 1979)

$$A \exp\left(B - C/T_r\right) - e_\infty = \left(\frac{k}{C_f D_v L}\right)\left(T_A - T_r\right)\left[P_A - A \exp\left(B - C/T_r\right)\right] \qquad (2\text{-}64)$$

where

$A = P_o/760$

C_f = molal concentration of the liquid (mol cm^{-3})

k = thermal conductivity of the gas mixture surrounding the drops at the drop surface temperature

B, C = constants obtained from tables expressing variations of vapor pressure with temperature (see, for example, page D-140, Handbook of Chemistry, 58th Edition, published by Chemical Rubber Co.)

Values of k, D_v and L for non-water drops must also be specified by the program user. The value of e_∞ for non-water drops can probably be set equal to zero. When the parameters required by Equation (2-64) have been specified, the program uses Newton's iteration procedures to determine the drop temperature and vapor pressure and the time-rate change of diameter, using the following expression (Fuchs, 1959) for the ventilation coefficient

$$\bar{f}_v = \frac{1}{2} Sh \qquad (2\text{-}65)$$

where

Sh = Sherwood number

$$= 2\left(1 + \alpha\, Sc^{1/3}\, Re^{1/2}\right) \qquad (2\text{-}66)$$

and α is set equal to 0.3 in the FSCBG program as suggested by Picot (1979).

Finally, for both water and non-water drops, the results obtained using the evaporation model for above canopy calculations are fitted with Equation (2-43) by least-squares over the time period required for the drop to evaporate to a diameter of 5 micrometers or the settling velocity to reach 0.02 m s^{-1}, whichever is greater. For calculations of evaporation effects below the canopy, Equation (2-43) is fitted to the evaporation model results over the time period required for the drop to travel from the top of the canopy to the ground.

The following parameters required by the evaporation model are based on meteorological measurements:

T_A = air temperature

P_A = air pressure

RH = relative humidity (for water drops)

The following parameters are source inputs required by the evaporation model:

M_ℓ = molecular weight of evaporating vapor

ρ_ℓ = density of the liquid for non-water drops

2.3 CANOPY PENETRATION MODEL

Grim and Barry (1975) developed a mathematical model to calculate the percentage material of a given drop-size category j which, after entering the forest at the top of the canopy, is retained at various levels within the canopy. The model is based on a Monte Carlo technique where a large number of drops in each size category are passed along a trajectory

through a simulated forest with trees assigned to equal areas according to the density (stems per acre) in the forest being simulated. The drop trajectory is a function of the gravitational settling velocity V_j, which varies along the trajectory when the evaporation model is used, and the mean wind speed at various levels within the canopy. As a drop proceeds along the trajectory, each tree is randomly displaced within the assigned area in the plane of the horizon and calculations are made to determine if the drop intersects the tree envelope and, if an intersection occurs, whether the drop strikes a tree element. When the drop strikes a tree element, a tally is recorded for the height interval within the canopy where the "hit" occurs and for all greater height intervals. Drops proceed along the trajectory until a hit occurs or until the trajectory intersects the ground. After the specified total number of drops in the size category have passed along the trajectory, the tally number within each height interval is divided by the total number of drops to obtain the percentage of drops reaching the given height interval. The total number of drops passed along the trajectory required to achieve a stabilized solution (percentage penetration) is a function of the steepness of the trajectory, with more drops being required for size categories with large settling velocities. In the FSCBG program, 500 drops in each size category are passed along the trajectory.

Figure 2-2 is a schematic diagram showing an example drop trajectory and forest construct. The drop trajectory in each of k height intervals is defined by the following piecewise linear function:

$$x_k = \begin{cases} 0 & ; \quad k=0 \\ \dfrac{0.25\ (k-1)\ H_c}{\tan \phi_k} + x_{k-1} & ; \quad k=1,\ 2,\ 3,\ 4 \end{cases} \qquad (2\text{-}67)$$

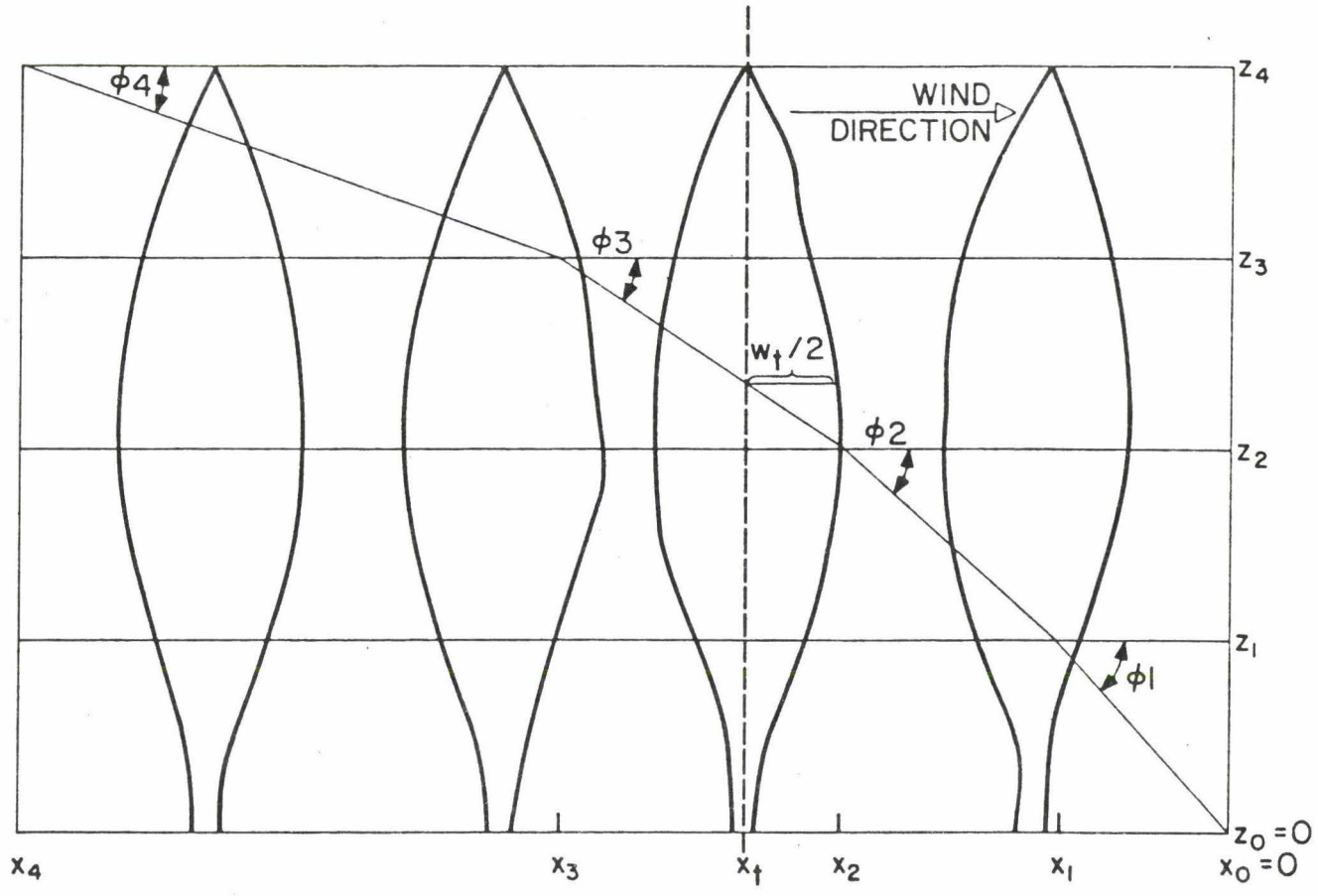

FIGURE 2-2. Schematic diagram showing an example drop trajectory and simulated forest.

$$y_k = 0 \tag{2-68}$$

$$z_k = 0.25kH_c \quad ; \quad k = 0, 1, 2, 3, 4 \tag{2-69}$$

where

ϕ_k = angle, measured in radians, defining the declination of the trajectory with respect to the plane of the horizon

$$= \begin{cases} \tan^{-1} \dfrac{V_j}{\bar{u}_{c;k}} & ; \quad \phi \leq 1.4 \text{ radians} \\ \\ 1.4 \text{ radians} & ; \quad \phi \geq 1.4 \text{ radians} \end{cases} \tag{2-70}$$

H_c = height of the forest canopy

$\bar{u}_{c;k}$ = mean wind speed in the k^{th} height interval within the canopy

In Figure 2-2 the trajectory is shown as a linear function in each height interval. When the evaporation model is used, the trajectory is curvilinear in each height interval. The number of trees placed along the trajectory path in the simulated forest is given by the expression

$$N_T = x_4/\Delta x_t \tag{2-71}$$

where

x_4 = maximum horizontal travel distance in meters of the drop within the forest canopy

Δx_t = alongwind tree spacing within the simulated forest

$$= 63.615/\sqrt{D_t} \tag{2-72}$$

D_t = tree density in units of stems per acre

As shown in Figure 2-3, each tree stem is given the following location along the trajectory:

$$x_t = (N_t - n)\,\Delta x_t + (R - 0.5)\,\Delta x_t \quad ; \quad n=1, 2, \ldots\ldots N_t \tag{2-73}$$

$$y_t = \left|(R' - 0.5)\,\Delta x_t\right| \tag{2-74}$$

where

n = tree number

and R and R' are uniform random numbers between 0 and 1. The possibility of the drop trajectory intersecting the tree envelope is determined by comparing the distance y_t with the radius of the tree envelope $(W_t/2)$ at the height z_p where the trajectory passes through the distance x_t. The tree widths W_t are specified by the program user at one-meter intervals and the program calculates the radius $(W_t/2)$ at z_p by linear interpolation. If y_t is greater than $(W_t/2)$, no intersection occurs and the computer program proceeds to the next tree along the trajectory.

If the drop trajectory intersects the tree envelope, the program calculates the probability that the drop impacts on a tree element from the expression

$$P_j = E_j(1 - \text{PRPEN}^{\zeta}) \tag{2-75}$$

where

E_j = impaction efficiency of the tree element for the j^{th} drop-size category

PRPEN = probability of penetration for the population of drops and for a horizontal trajectory through the tree

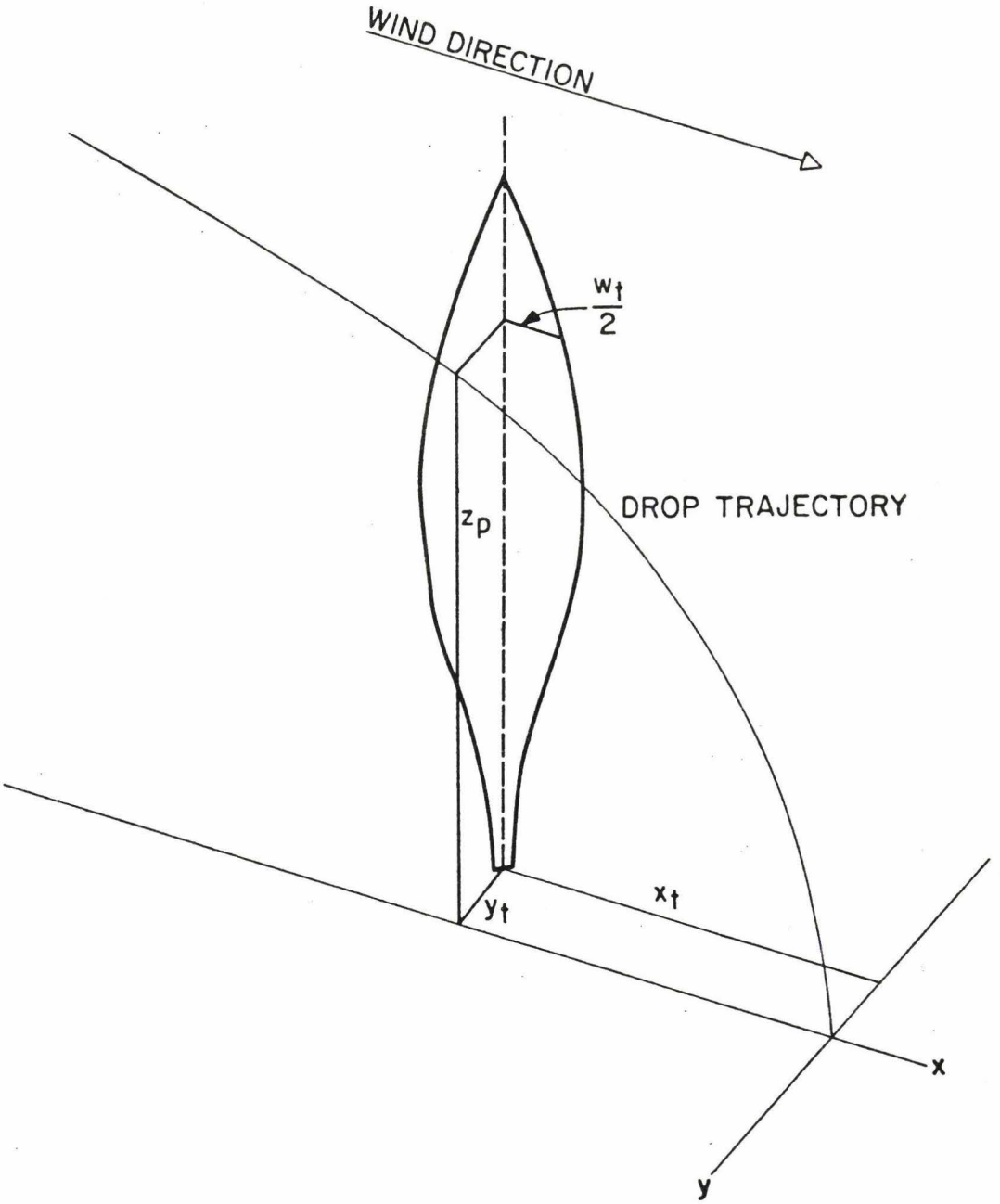

FIGURE 2-3. Schematic diagram showing the coordinate location of the "random tree".

ζ = path length correction factor for a non-horizontal trajectory

$$= \begin{cases} \dfrac{1}{\cos \phi_k} & ; \quad \zeta \leq \dfrac{H_c}{W_m} \\ \dfrac{H_c}{W_m} & ; \quad \zeta > \dfrac{H_c}{W_m} \end{cases} \tag{2-76}$$

W_m = maximum width of the tree envelope

In the FSCBG computer program, the user has the option of entering the impaction efficiency E_j for each drop-size category or permitting the program to calculate E_j from the following empirical relationship, recommended by Grim and Barry (1975) and attributed to Sell:

$$E_j = \begin{cases} \dfrac{2.84 \times 10^4 \, D_j^2 \, v}{s} & ; \quad E_j \leq 1 \\ 1 & ; \quad E_j > 1 \end{cases} \tag{2-77}$$

where

v = impaction velocity (ms^{-1})

$$= \left[(\bar{u}_{c;k})^2 + V_j^2 \right]^{1/2} \tag{2-78}$$

s = diameter of the element on which the drop impacts (cm)

A particular drop of the population of drops is assumed to intersect the tree element when the value of P_j from Equation (2-75) is greater than a uniform random number R between 0 and 1. Each tree is divided into ten height-class intervals, and an intersection with a tree element is recorded as a "hit" in the class interval in which z_p occurs and in every higher class interval.

The process described above is repeated for every drop passed along the trajectory and the final percentage of material penetrating to a given height interval determined by dividing the number of recorded hits in the height interval by the total number of drops in all j^{th} size categories passed along the trajectory. When the evaporation model is used, the mass or number of drops reaching a given level in the canopy is further adjusted to account for losses due to evaporation.

The inputs required by the canopy penetration model are:

PRPEN = probability of penetration

$\bar{u}_{c;k}$ = mean wind speed in the k^{th} height interval within the forest canopy

D_t = tree density in stems per acre

H_c = tree height in meters

W_i = tree width at one-meter height intervals

The computer program also permits the user to simulate a multi-storied canopy of up to three tree heights, with a different value of PRPEN possible for each tree or story height. The authors vary the values of PRPEN as a function of the four foliage types illustrated in Figure 2-4.

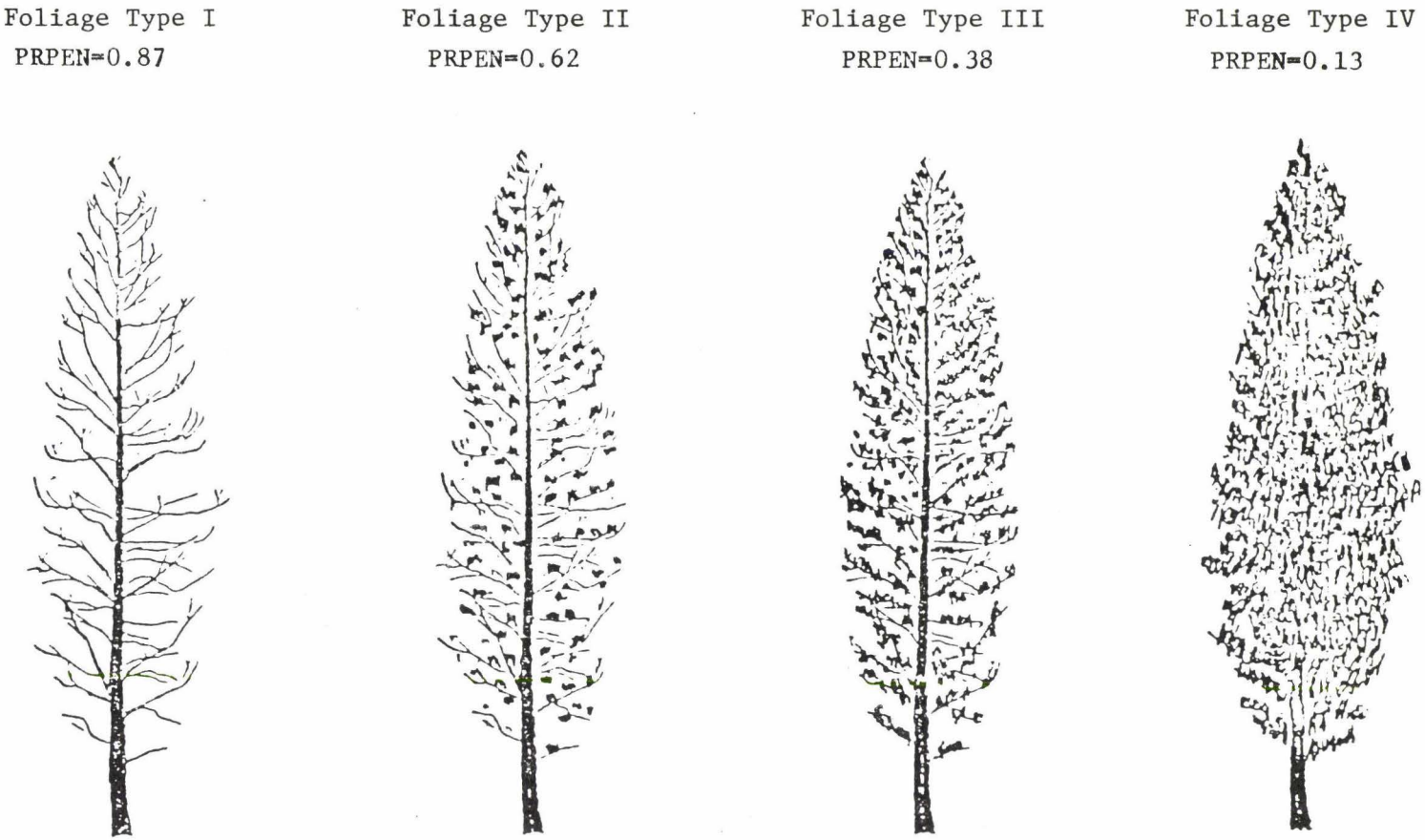

FIGURE 2-4. Diagram illustrating four foliage types suggested for use in classifying forests (after Grim and Barry, 1975).

The output from the canopy penetration model includes, in addition to the percentage of material in the j^{th} drop size category penetrating to each of ten levels within the canopy, the maximum horizontal travel distance of the drop within the forest canopy (x_4). When the deposition models described in Section 2.1 are used in conjunction with the canopy penetration model to calculate deposition within the canopy, the distance from the line source to the target is adjusted so that the deposition model calculates the deposition at the top of the forest canopy at a distance x_4 upwind from the target. The deposition at the target is then determined by multiplying the deposition calculated from the deposition models in Section 2.1 by the percentage of material reaching the calculation height from the canopy penetration model.

2.4 AIRCRAFT WAKE MODEL (WAKE SETTLING VELOCITY MODEL)

During a short time period after spray is released from an aircraft, the vortices formed by the wings and propellers of fixed-wing aircraft and by helicopter rotors principally control the growth of the spray cloud. Except for the lateral translation of the vortex system by a crosswind, the vortices also control the position in space of the spray cloud and the amount of material which may be deposited on the underlying surface directly below the flight path. There are a number of sophisticated models presented in the literature describing conventional aircraft wake action (C. duP. Donaldson and A. J. Bilanin, 1975) and associated computer programs (Hirsh, 1978). Wickens (1977) has used numerical simulation models which neglect atmospheric diffusion to describe the effects of aircraft wake vortices on aerial spray deposition. Currently, the USFS is cosponsoring an effort with the National Aeronautics and Space Administration (NASA) to further investigate wake effects on spray deposition (Eckblad, 1980).

The relatively complex wake model programs currently available would, if incorporated with the dispersion evaporation and canopy penetration

codes in the FSCBG program, greatly increase the computation time required to estimate deposition patterns. From discussions with USFS personnel and others involved in the USFS-NASA program on wake effects, it appeared that simpler wake models and computer codes may soon be available. For these reasons, the FSCBG program has been designed so that wake computer codes can easily be modified and/or added to the program. Since the importance of wake effects was recognized, the version of the FSCBG code described in this report contains an interim wake-effects model we have found useful in previous work (Dumbauld, Rafferty and Bjorklund, 1977).

Prandtl and Tietjens (1934) express the sink rate ω (m s^{-1}) of a vortex system as

$$\omega = \frac{8g\ W_a}{\pi^3\ \rho_A\ b^2\ V_a} \left(10^{-3}\right) \qquad (2\text{-}79)$$

where

W_a = weight of the aircraft (kg)

g = accelleration due to gravity (9.8 m s^{-2})

ρ_A = air density (g cm^{-3})

b = aircraft wing span (m)

V_a = aircraft speed (m s^{-1})

Equation (2-79) is strictly applicable to fixed-wing aircraft. However, as pointed out by the Bell Helicopter Company (1966 and updates), helicopter-produced vortices resemble fixed-wing vortices at high forward speeds.

In the spray dispersion models described in Section 2.1 above, the source parameters correspond to the spray cloud properties when the cloud has reached approximate atmospheric equilibrium. The vortex sink rate

calculated from Equation (2-79) and the observations that the vortex tube stops descending at a distance (b/2) above the surface (Jones, 1970) or above the forest canopy are used to calculate source parameters for the models. Figure 2-5 is a schematic diagram showing the geometrical considerations used in specifying the distance downwind x_R at which cloud stabilization occurs and the effective release height H'_j. As shown in Figure 2-5, the cloud descent from the aircraft at height H forms the angle $\tan^{-1}(\omega/\bar{u})$ with the horizontal when the gravitational settling velocity for the j^{th} drop-size category at height $H(V_{j;H})$ is less than ω. In general, the FSCBG program calculates the distance downwind from the flight path where the cloud reaches a height b/2 above the surface from the expression

$$x_R = \bar{u}\, t'_j \tag{2-80}$$

where

t'_j = effective time for the cloud centroid to reach the height b/2

$$= \begin{cases} (H - (b/2) - H_c) / \omega & ; \quad \omega \geq V_{j;H} \\ t_{j;b/2} & ; \quad \omega \leq V_{j;H} \end{cases} \tag{2-81}$$

$V_{j;H}$ = gravitational settling velocity for the j^{th} drop-size category at the aircraft flight altitude

$t_{j;b/2}$ = time for the drop in the j^{th} category to reach the height b/2 above the ground or canopy, calculated from the evaporation model

As noted in Section 2.1, the dispersion models are formulated under the assumption that the cloud axis descends at an angle $\tan^{-1}(V_j/\bar{u})$ with the

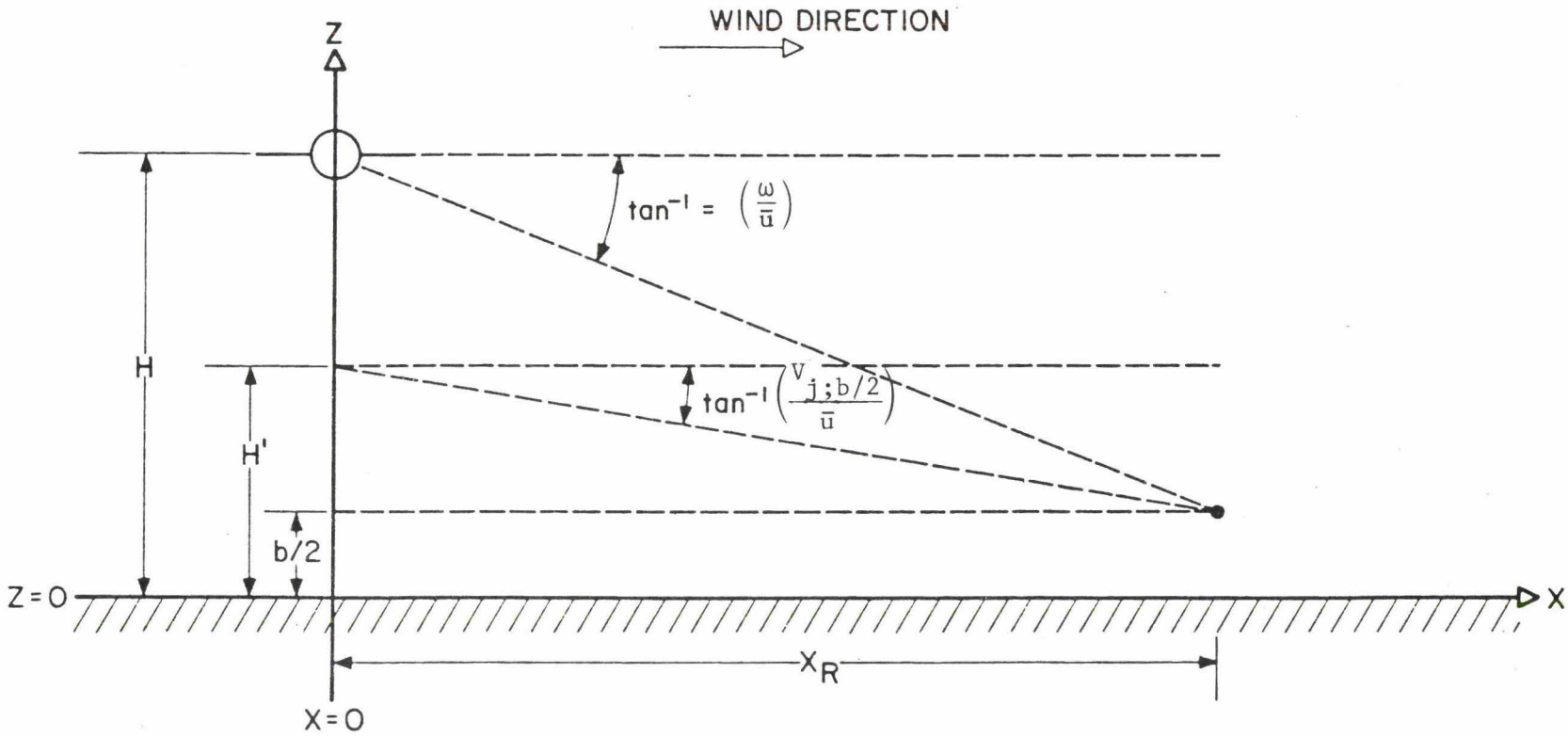

FIGURE 2-5. Schematic diagram showing geometry used in constructing the distance x_R and effective source height H' for the case when the settling velocity in the j^{th} size category at height H ($V_{j;H}$) is less than ω.

horizontal. We have therefore assumed that the effective declination of the cloud axis downwind from an effective source height H'_j is given by the angle $\tan^{-1}(V_{j;b/2}/\bar{u})$, where $V_{j;b/2}$ is the gravitational settling velocity calculated by the program for the drop at the height b/2. Based on this assumption, the effective release height H'_j is

$$H'_j = H_c + (b/2) + t'_j V_{j;b/2} \qquad (2\text{-}82)$$

All gravitational settling velocities are calculated in the FSCBG program using a technique suggested by McDonald (1960). The graph given by McDonald expressing the relationship between the drag coefficient of spheres and their Reynolds number, has been fitted for Reynolds numbers less than $2x10^5$ and is used in the FSCBG program.

2.5 ADJUSTMENTS OF DEPOSITION CALCULATIONS FOR EVAPORATION

When no evaporation occurs, the calculation of deposition using Equations (2-31) through (2-32) is relatively straightforward because the gravitational settling velocity is invariant with time. However, when evaporation occurs both drop size and gravitational velocity vary with travel distance from the source and the deposition calculations become more complicated. To illustrate the procedures used by the computer program to calculate deposition with evaporation occurring, assume that we wish to calculate ground-level deposition for the j^{th} drop-size category at a distance of 75 meters downwind from an aircraft release at a height of 18.1 meters above the ground. The top of the canopy is at a height of 12 meters above the ground. The program follows the stepwise procedure outlined below.

(1) The program uses the above-canopy evaporation model described in Section 2.2 to establish a curve relating the

gravitational settling velocity (V_j) of the median drop in the j^{th} size category as a function of travel distance (x) from the source for above-canopy meteorology. A typical curve (for drop-size category 9 of the example problem explained in Section 4 and a relative humidity of 50 percent) is shown in Figure 2-6.

(2) The above-canopy evaporation model is also used to calculate the height trajectory of the drop as a function of travel distance. The curve for drop-size category 9 in the example problem for 50-percent humidity is shown in Figure 2-7. Note that the curve extends to negative heights because a drop in this category would have fallen this distance except for the effects of vertical dispersion above the canopy.

(3) The below-canopy evaporation model is used to calculate the trajectory of the drop in the j^{th} size category, using below-canopy meteorology and assuming that the drop entered the canopy with the settling velocity V_{jc} given by the above-canopy evaporation model at the canopy height. In addition to calculating the mass loss within the canopy, the below-canopy evaporation model calculates the travel distance (DISTM) of the drop from the time it enters the canopy until it strikes the ground.

(4) The program internally develops a curve relating the difference between the receptor distance from the source and the travel distance in the canopy $(X\text{-}DISTM)_j$ for all the drop-size categories versus the settling velocity at the canopy top V_{jc} for each j^{th} category. The curve for our example is shown by the nearly vertical line in Figure

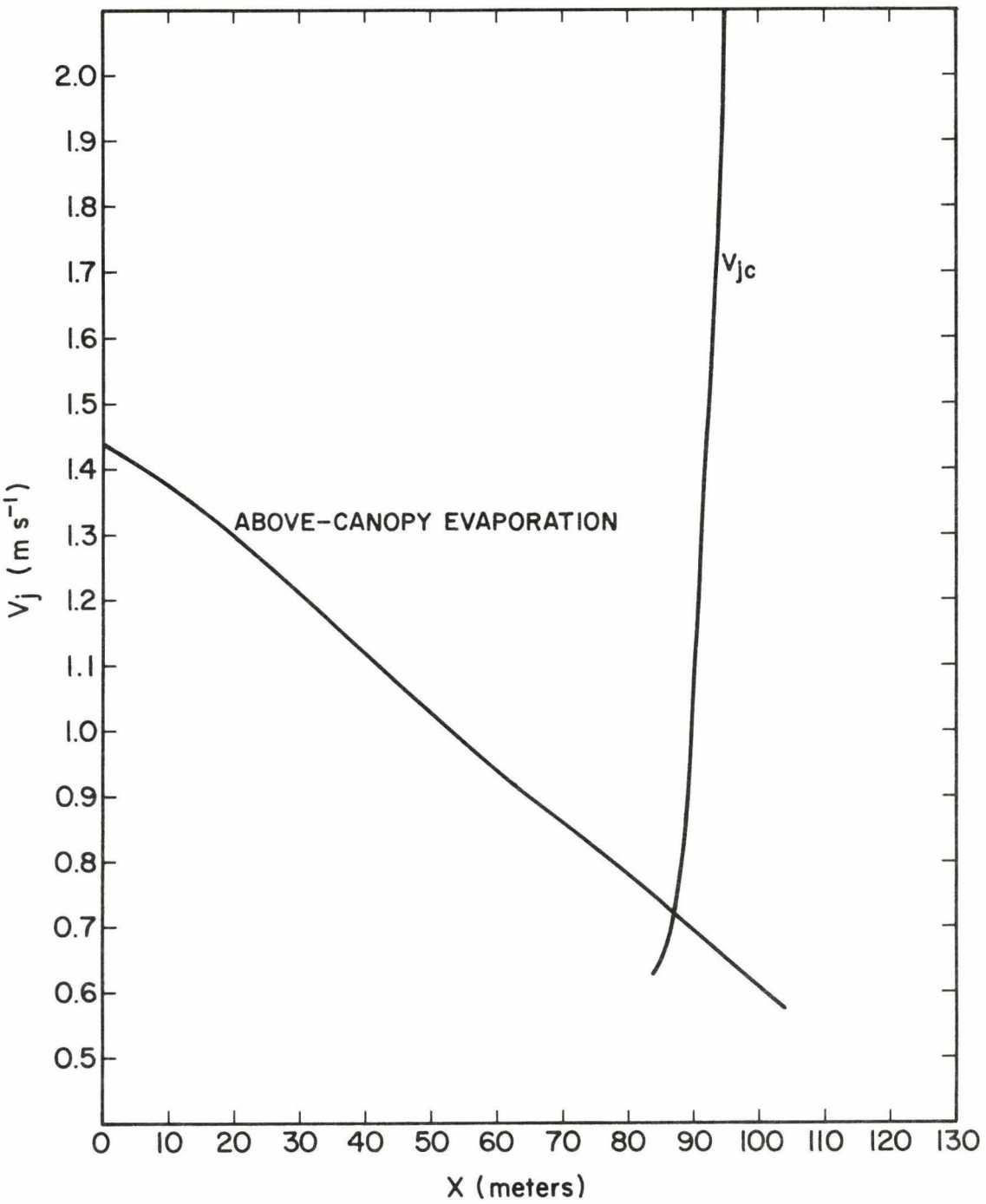

FIGURE 2-6. Gravitational settling velocity V_j versus distance from the source (see Section 2.5).

2-6, where the quantity $(X\text{-}DISTM)_j$ is plotted as X and V_{jc} is plotted as V_j.

(5) The intersection of the curve developed in step (4) above and the above-canopy evaporation curve for drop-size category 9 shown in Figure 2-6 defines the distance from the source to the point where a drop in size category 9 would have to enter the canopy in order to reach the vicinity of our receptor at a distance of 100 meters from the source. Thus, for our example, the drop in size category 9 would enter the canopy at a distance of 87 meters downwind from the source.

(6) The effective height H" of the cloud centroid for size category 9 at a distance of 87 meters from the source is obtained from the height versus distance curve shown in Figure 2-7. For our example, Figure 2-7 shows that H" is about -74 meters.

(7) The deposition model equations yield the corrected deposition values when an effective value of V_j is used in solving Equation (2-31) through Equation (2-42). Thus, the effective value of the gravitational settling velocity is

$$V_j = \frac{\bar{u}(H_j' - H'')}{x}$$

where H_j' is given by Equation (2-82) and, for our example, x is 87 meters and H" is -74 meters.

The calculations then proceed in the usual fashion except for appropriate adjustments for mass loss due to evaporation.

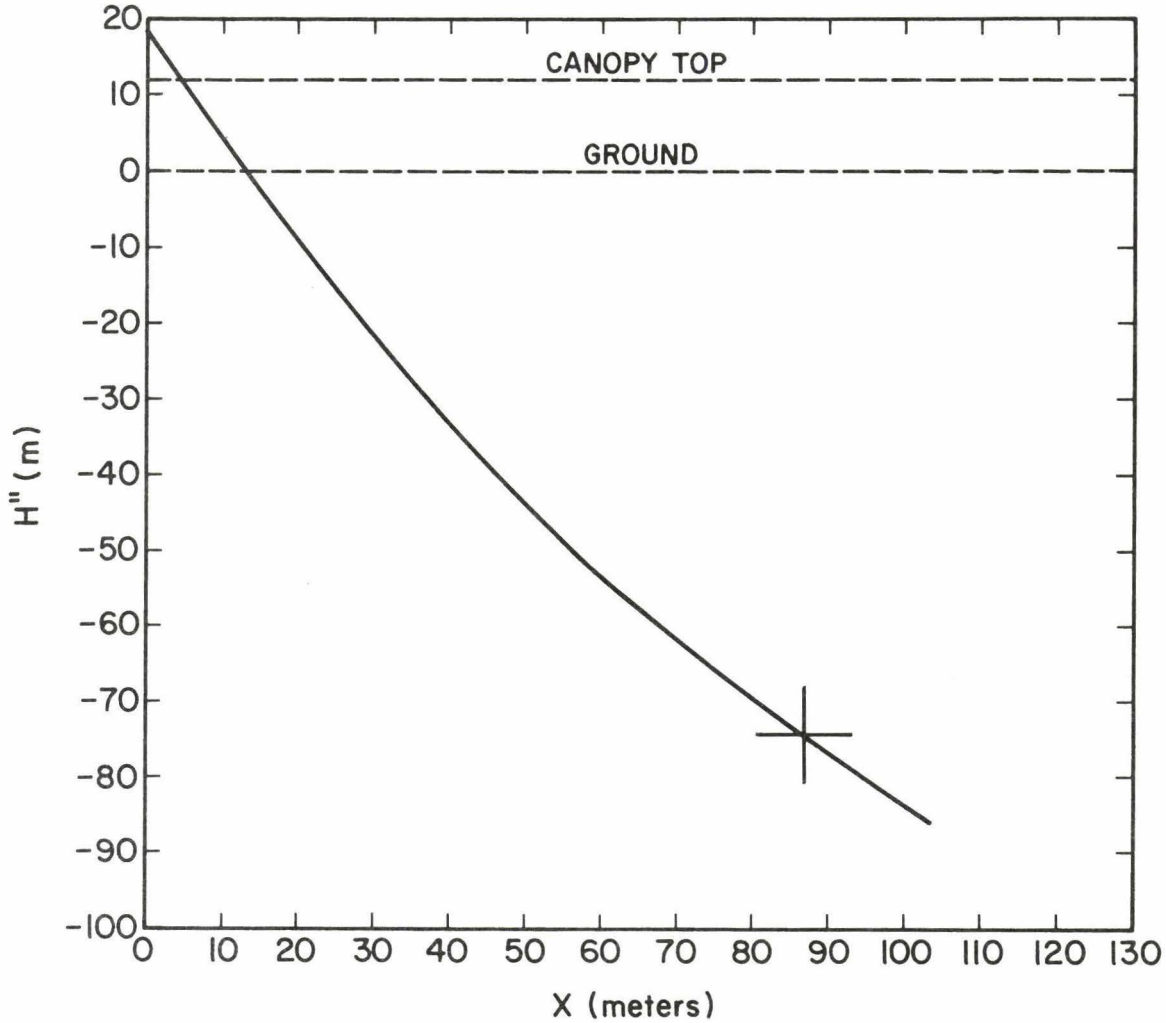

FIGURE 2-7. Height of drop in size category 9 versus distance from the source (see Section 2.5).

SECTION 3

USERS INSTRUCTIONS FOR THE FSCBG COMPUTER PROGRAM

3.1 SUMMARY OF PROGRAM MODEL OPTIONS, DATA REQUIREMENTS AND OUTPUT

3.1.1 Summary of FSCBG Program Model Options

The program model options of the FSCBG computer program consists of four general categories:

- Wake-Settling Velocity Model
- Drop Evaporation Model
- Canopy Penetration Model
- Dispersion Models

Each category is discussed separately below.

Wake-Settling Velocity Model. The FSCBG computer program provides the option of allowing the user to input the wake-settling velocity or allowing the FSCGB program to calculate the wake-settling velocity, providing the user inputs the weight of the aircraft, the ground speed of the aircraft and the wing span of the aircraft or helicopter rotor diameter.

Drop Evaporation Model. The FSCBG program requires the user to input the spray drop-size distribution. The other program models use these data with or without drop-size changes due to evaporation. If the user chooses to use the drop-size distribution without changes due to evaporation, the drop size as well as all related drop information (settling velocity, etc.) is assumed to be constant with time. However, if the user chooses to apply evaporation to the drop distribution, the program will determine the rate of change of the drop size as well as all related drop information (settling velocity, etc.) as a function of time. If desired, the FSCBG

program permits the user to specify the rate of change of drop size for each drop-size category as a function of time. If this option is chosen, the program requires the user to specify, for each drop-size category above the canopy, the coefficients a, b, and c of the equation [drop = $a + b \cdot t + c \cdot t^2$], where drop is the drop diameter in micrometers and t is the time in seconds from release. Also, the program permits the user to specify a different set of coefficients (a, b and c) for each drop-size category giving the time rate of change of drop size within the forest canopy.

Canopy Penetration Model. The user may run the FSCBG program with or without a forest canopy. A forest canopy may be any vegetation that extends above the ground, where the canopy can be described using up to 3 vegetative height classes. The canopy penetration model calculates the percentage of material in each drop-size category that reaches each tenth of the canopy height. Also, the canopy penetration model determines the horizontal path length of the trajectory of each drop-size category. This information can be optionally printed and is supplied to the dispersion model (if used) for application in the calculation of dosage, concentration and/or deposition.

Dispersion Models. The user has the option of using the dosage, concentration or deposition models or any combination of these models. The program on option will calculate the dosage, concentration and/or deposition at the specified receptor points and at the specified height. At present, dosage and concentration calculations are restricted to heights at or above the canopy height. There are no similar height restrictions on deposition calculations.

3.1.2 Data Input Requirements

This section provides a description of all input data parameters required by the FSCBG program. The user should note that some input parameters are not read or are ignored by the program depending on the values control parameters have been assigned by the user.

Program Control Parameter Input Data. These parameters provide user-control of all program options.

Parameter Name	
TITLE	Titling Information -- This parameter is an array of a maximum of 80 characters specifying the case title. If not input, the program defaults to a blank title.
ISW(1)	Wake-Settling Velocity Option -- This parameter specifies whether the wake-settling velocity is to be input by the user or is to be calculated by the program. If this parameter is set equal to "0" or omitted, the FSCGB program assumes the user desires to input the wake-settling velocity via the parameter WAKVEL below. If this parameter is set equal to "1", the program calculates the wake-settling velocity from the input parameters ARCRWT, WNGSPN, ARCRSP and AIRDEN, defined below.
ISW(2)	Evaporation Model Option -- This parameter specifies whether or not evaporation is to be applied to the drop distribution or whether the user is to input the rate of evaporation of the drops. If this parameter is set equal to "0" or omitted, the program assumes the drops do not evaporate, and passes the drop-size distribution to subsequent program phases unchanged. Also, all equations related to drop size and time assume the drop size is constant with time. If this parameter is set equal to a value of "1", the program calculates the evaporation rate for each drop-size category. The program automatically calculates the drop size as a function of time and the amount of material converted to vapor. The evaporation model is applied to the drop distribution both above and below a forest canopy and the evaporated

Parameter Name	
ISW(2) (Cont.)	drop distributions are passed to subsequent program phases. If this parameter is set equal to "2", the FSCBG program assumes the user desires to input the coefficients a, b and c of the equation giving the drop diameter as a function of time, e.g., $D = a + b \cdot t + c \cdot t^2$. One set of the coefficients a, b and c is required for each drop-size category for both above and below a forest canopy. The variable D in the above equation is the drop diameter in micrometers and t is the time after release.
ISW(3)	Canopy Penetration Model Option -- This parameter controls execution of the canopy penetration model. If this parameter is set equal to "0" or omitted, a forest canopy is not considered in the FSCBG calculations. All input parameters relating to a forest canopy are ignored by the program. If this parameter is set equal to "1", the program assumes there is a forest canopy. The forest canopy may be an actual forest or may be any above-ground vegetation. The canopy penetration model determines the percentage of the drop material from each size category that reaches 10 height levels within the forest canopy, including the ground. If this parameter is set equal to "2", the canopy penetration model calculations are printed as well as calculated.
ISW(4)	Dispersion Models Option -- This parameter controls execution of the dispersion models. If this parameter is set equal to "0" or omitted, the dispersion models (dosage, concentration, deposition) are not executed. All dispersion model related parameters are ignored by the program. If this parameter is set equal to "1", the dispersion models

Parameter Name	
ISW(4) (Cont.)	given by ISW(6), ISW(7) and ISW(8) are executed and the calculations printed.
ISW(5)	Print Evaporation Model (ISW(2)) Calculations Option -- This parameter controls printing of calculations selected under ISW(2). If this parameter is set equal to "0" or omitted, calculations under ISW(2) are not printed. If this parameter is set equal to "1", calculations under ISW(2) are printed.
ISW(6)	Dosage Model Option -- This parameter controls dosage calculations. If this parameter is set equal to "0" or omitted, dosage is not calculated. If this parameter is set equal to "1", dosage at the height specified by Z is calculated and printed. Note that dosage calculations can only be made at heights Z from the top of the forest canopy to the mixing layer height HM.
ISW(7)	Concentration Model Option -- This parameter controls concentration calculations. If this parameter is set equal to "0" or omitted, concentration is not calculated. If this parameter is set equal to "1", concentrations at the height specified by Z are calculated and printed. Note that concentration calculations can only be made at heights Z from the top of the forest canopy to the mixing layer height HM.
ISW(8)	Deposition Model Option -- This parameter controls deposition calculations. If this parameter is set equal to "0" or omitted, deposition is not calculated. If this parameter is set equal to "1", deposition at the height specified by Z is calculated and printed. There are no restrictions

Parameter Name	
ISW(8) (Cont.)	on the calculation height Z for deposition calculations, e.g., deposition can be calculated within the forest canopy.
ISW(9)	Dosage, Concentration and Deposition Output Mass Units -- This option assumes the user has input the release rate Q in units consistent with the definitions of Q and with the parameter SWATH below. All units conversions are handled automatically by the program. The possible output units are:

ISW(9)	Output Units
0 or omitted	drops
1	micrograms
2	milligrams
3	grams
4	ounces
5	pounds

ISW(10) Dosage Output Time Units Option -- This option assumes the user has input all parameters dependent on time in units of seconds. The possible output units are:

ISW(10)	Output Units
0 or omitted	seconds
1	minutes

ISW(11) Dosage, Concentration and Deposition Output Volume or Area Length Units Option -- This option assumes the user has input all parameters dependent on length in units of meters. The possible output units are:

Parameter Name

ISW(11) (Cont.)

ISW(11)	Dosage	Concentration	Deposition	Area-Coverage
0 or omitted	m^3	m^3	m^2	m^2
1	ft^3	ft^3	ft^2	ft^2
2	m^3	m^3	acre	acre
3	ft^3	ft^3	acre	acre
4	m^3	m^3	hectare	hectare

ISW(12) Area-Coverage Option -- This option enables the user to calculate the total horizontal area coverage for up to 10 levels of dosage, concentration and/or deposition. If this parameter is set equal to "0" or omitted, area-coverage is calculated for dosage, concentration and/or deposition, depending on ISW(6), ISW(7) and ISW(8), respectively.

ISW(13) - ISW(20 Reserved for Future Options.

Necessary FSCBG Program Input Parameters. These parameters are used by more than one of the FSCBG program models.

Parameter Name

IFWATR Spray Liquid Base -- This parameter is a switch used to inform the FSCBG program when the theoretical calculation for water drop evaporation is to be used. If this parameter is set equal to "1" or omitted, the program assumes the theoretical drop evaporation equations for water are to be used. If this parameter is set equal to "2", the program assumes the spray liquid is not water, but calculates a theoretical evaporation rate requiring these additional input parameters -

Parameter Name	
IFWATR (Cont.)	DFUSIV, HETLAT, CONMOL, THERMC, VAPINF, BCONST and CONST defined below.
WNGSPN	Aircraft Wing Span -- This parameter specifies the aircraft wing span or helicopter rotor diameter in meters (m).
WSOCAN	Wind Speed -- This parameter specifies the wind speed in meters per second (m s^{-1}) above the canopy.
HGTCFT	Height of Aircraft -- This parameter specifies the height above ground in meters (m) of the spray aircraft.
DENLIQ	Density of the Drop Liquid -- This parameter specifies the density of the spray drop liquid in grams per cubic centimeter (g cm^{-3}). If this parameter is omitted from the input data, the program defaults to a density of 1.0 gram per cubic centimeter.
AIRTPO	Air Temperature Above the Canopy -- This parameter specifies the air temperature in degrees Celsius (^{o}C) above the canopy.
AIRTPU	Air Temperature Below the Canopy -- This parameter specifies the air temperature in degrees Celsius (^{o}C) below the canopy. If this parameter is omitted from the input data, the program defaults to the value input to AIRTPO.
AIRDEN	Air Density -- This parameter specifies the air density in grams per cubic centimeter (g cm^{-3}). If this parameter is omitted from the input data, the parameters AIRMOL, AIRPRS and VAPINF defined below, must be input to the FSCBG program.

Wake-Settling Velocity Model Input Data. These parameters are used in calculating the aircraft wake-settling velocity. The parameter ISW(1) specifies which of the parameters described in this section are required by the program.

Parameter Name	
	Parameters Required When (ISW(1) Equals "0" or is Omitted
WAKVEL	Wake Settling Velocity -- This parameter specifies the wake-settling velocity in meters per second ($m\ s^{-1}$).
	Parameters Required When ISW(1) Equals "1"
ARCRWT	Aircraft Weight -- This parameter specifies the weight of the aircraft in kilograms (kg) for the calculation of the wake-settling velocity.
ARCRSP	Aircraft Ground Speed -- This parameter specifies the ground speed in meters per second ($m\ s^{-1}$) of the spray aircraft for the calculation of the wake-settling velocity.

Evaporation Model Input Data. These data are parameters used in calculations within the Evaporation Model. The parameter ISW(2) specifies which of the parameters in this section are required by the program.

Parameter Name	
	Parameters Required When ISW(2) Equals "0", "1" or is Omitted
DRPUPR	Upper Limits for the Drop-Size Categories -- This parameter is an array specifying the upper limit of each drop-size

Parameter Name	
DRPUPR (Cont.)	category in micrometers (μm) for up to 20 drop-size categories. These values must be input in descending order of diameter and the number of drop-size categories is determined by the program from the number of non-zero input values. If ISW(2) is equal to "0" or omitted, this array may be the mean diameter.
DRPLWR	Lower Limits to the Drop-Size Categories -- This parameter is an array specifying the lower limit of each drop-size category in micrometers (μm) for the same number of drop-size categories input to the array DRPUPR. The lower limit of any drop size category cannot be zero ("0"). If the mean diameter is input to the array DRPUPR, this array is omitted from the input data.
	Parameters Required When ISW(2) Equals "1"
AIRPRS	Air Pressure -- This parameter specifies the barometric pressure in millibars (mb) at the site altitude. If this parameter is omitted from the input data, the program uses 1013.25 millibars as a default value. If the parameter AIRDEN has been omitted, this parameter is required.
AIRMOL	Molecular Weight of Air -- This parameter specifies the molecular weight of air. If this parameter is omitted from the input data, the program uses 28.9644 as a default value. If the parameter AIRDEN has been omitted, this parameter is required.
VAPMOL	Molecular Weight of the Vapor -- This parameter specifies the molecular weight of the vapor from the evaporating

Parameter Name	
VAPMOL (Cont.)	drops. If this parameter is omitted from the input data, the program uses 18.015 as a default value.
RELHMO	Relative Humidity Above the Canopy -- This parameter specifies the relative humidity above the canopy in percent (%). This parameter is required if AIRDEN equals zero or is omitted and VAPINF is omitted from the input data.
RELHMU	Relative Humidity Below the Canopy -- This parameter specifies the relative humidity below the canopy in percent (%). If this parameter is omitted from the input data, the program uses the humidity above the canopy (RELHMO) as a default value. This parameter is required if AIRDEN equals zero or is omitted and VAPINF is omitted and a canopy is being used.

Parameters Required When ISW(2) Equals "1" and IFWATR Equals "2"

DFUSIV	Diffusivity of Evaporating Vapor -- This parameter is required for liquids other than water (IFWATR="2") and specifies the diffusivity of the evaporating vapor into the air at the drop temperature in square centimeters per second ($cm^2\ s^{-1}$). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates DFUSIV, assuming the liquid is similar to water via the equation

$$DFUSIV = .211 \cdot \left((T_D+273.16)/273.16\right)^{1.94} \cdot \left(1013.25/AIRPRS\right) \quad (3\text{-}1)$$

where T_D is the drop temperature approximated by the program.

HETLAT	Latent Heat of Vaporization -- This parameter is required only for liquids other than water (IFWATR="2") and specifies

Parameter Name	
HETLAT (Cont.)	the latent heat of vaporization at the drop temperature in calories per mole (cal $mole^{-1}$). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates HETLAT, assuming the liquid is similar to water, via the equation

$$HETLAT = 597.3 \cdot \left(273.16/(T_D+273.16)\right)^{A} \cdot VAPMOL \qquad (3\text{-}2)$$

where:

$A = 0.107+3.67x10^{-4} \cdot (T_D+273.16)$

T_D = drop temperature (^oC) approximated by the program

CONMOL — Molal Concentration -- This parameter is required only for liquids other than water (IFWATR="2") and specifies the molal concentration of the air-liquid mixture in moles per cubic centimeter (moles cm^{-3}). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates CONMOL, assuming the liquid is similar to water, via the equation

$$CONMOL = AIRDEN/AIRMOL \qquad (3\text{-}3)$$

THERMC — Thermal Conductivity -- This parameter is required only for liquids other than water (IFWATR="2") and specifies the thermal conductivity of the vapor into air at the drop temperature in calories per second centimeter degree Kelvin (cal s^{-1} cm^{-1} $^oK^{-1}$). If this parameter is omitted from the input data and IFWATR equals "2", the program calculates THERMC, assuming the liquid is similar to water, via the equation

Parameter Name

THERMC (Cont.)

$$THERMC = A\left(1-\left(1.17-1.02\left(B/A\right)\right)\right) VAPINF/AIRPRS \qquad (3\text{-}4)$$

where

$A = 5.69\times10^{-5}+1.7\times10^{-7}\cdot DRPTMP$

$B = 3.78\times10^{-5}+2.0\times10^{-7}\cdot DRPTMP$

DRPTMP = calculated drop temperature (^{o}K)

VAPINF = vapor pressure of vapor at infinity (mb)

AIRPRS = barometric pressure (mb)

VAPINF

Vapor Pressure at Infinity -- This parameter is required for liquids other than water (IFWATR="2") and is also required if AIRDEN equals zero or has been omitted from the data deck. This parameter specifies the vapor pressure of the evaporating vapor at infinity in millibars (mb). If VAPINF is input greater than or equal to zero, this value is used. However, if this parameter is omitted from the input data, the program calculates the value of VAPINF from the air temperature (AIRTPO,AIRTPU) and relative humidity (RELHMO,RELHMU).

BCONST & CCONST

Vapor Pressure Equation Constants -- These two parameters are constants used in the equation that describes the vapor pressure as a function of temperature of the non-water (IFWATR="2") liquid via the expression

$$\text{vapor pressure (in Hg)} = \exp\left(BCONST-CCONST/T_D\right) \qquad (3\text{-}5)$$

where T_D is the drop temperature (^{o}C) approximated by the program. The default values for these parameters are 21.07 and 5249.9 for BCONST and CCONST, respectively.

Parameter Name	
	Parameters Required When ISW(2) Equals "2" (User Specifies Time Rate of Evaporation).
DAU, DBU & DCU	Time Rate of Change of Drop Size Above Canopy -- These three arrays specify the coefficients of the equation describing drop size as a function of time above the canopy

$$D(\text{micrometers}) = DAU(J)+DBU(J)\cdot T+DCU(J)\cdot T^2 \qquad (3\text{-}6)$$

where D is the diameter of the drop in micrometers (μm), T is the time in seconds after the spray is released and J is the index over the drop-size categories. There are a maximum of 20 values possible for each array. The number of drop-size categories is determined by the program by the number of input values of DAU. The values in each array must be ordered in descending order of drop-size category.

DAL, DBL & DCL	Time Rate of Change of Drop Size Below Canopy -- These three arrays specify the coefficients of the equation describing drop-size as a function of time below the canopy

$$D(\text{micrometers}) = DAL(J)+DBL(J)\cdot T+DCL(J)\cdot T^2 \qquad (3\text{-}7)$$

where D is the diameter of the drop in micrometers (μm), T is the time in seconds after the spray is released and J is the index over the drop-size categories. There are a maximum of 20 values possible for each array. The values in each array must be ordered in descending order of drop-size category. If any values for these three arrays are omitted from the input data, the program defaults the respective value from the arrays DAU, DBU and DCU.

Canopy Penetration Model Input Data. These parameters are used in calculations performed by the Canopy Penetration Model and are required by the program only if the parameter ISW(3) is set equal to "1".

Parameter Name	
WSIN44	Wind Speed in Top Quarter of Canopy -- This parameter specifies the wind speed in meters per second (m s^{-1}) for the top quarter of the canopy. If this parameter is omitted from the input data, the program uses the wind speed above the canopy (WSOCAN) for WSIN44.
WSIN34	Wind speed in the Third Quarter of Canopy -- This parameter specifies the wind speed in meters per second (m s^{-1}) for the third quarter of the canopy. If this parameter is omitted from the input data, the program uses the value of WSIN44.
WSIN24	Wind Speed in the Second Quarter of Canopy -- This parameter specifies the wind speed in meters per second (m s^{-1}) for the second quarter of the canopy. If this parameter is omitted from the input data, the program uses the value of WSIN34.
WSIN14	Wind Speed in the Bottom Quarter of Canopy -- This parameter specifies the wind speed in meters per second (m s^{-1}) for the bottom quarter of the canopy. If this parameter is omitted from the input data, the program uses the value of WSIN24.
HGTCAN	Height of Canopy -- This parameter is an array specifying the height in whole meters (m) of up to three canopy (vegetation) height categories (multi-storied canopy). These values must be input in descending order of height. The

Parameter Name	
HGTCAN (Cont.)	number of canopy height categories is determined by the program from the number of non-zero input values of HGTCAN. There are a maximum of three height categories.
PRBPEN	Probability of Drop Penetration -- This parameter defines an array specifying the probability of drop penetration for a horizontal trajectory through the tree (stem) for up to three canopy height categories. These values are input as fractions in the range of "0" to "1", depending on the density of the vegetation and in the same order as values input to the array HGTCAN.
TREDEN	Tree Density -- This parameter is an array specifying the density of trees per acre (stems $acre^{-1}$) for each canopy height category defined by HGTCAN.
COLEFF	Collection Efficiencies -- This parameter is an array that either specifies the collection efficiencies for each drop-size category or specifies the size of the vegetative elements for each canopy height category, depending on whether the values are negative or positive. If the values input to this array are positive, the program assumes they are the collection efficiencies for each drop-size category. If the values input to the array COLEFF are negative, the program assumes the absolute values are the diameters in centimeters of the vegetative element on which the drop impacts for each canopy-height category. The collection efficiencies are then internally calculated using the following empirical relationship, recommended by Grim and Barry (1975) and attributed to Sell

Parameter Name

COLEFF (Cont.)

$$EFF = \begin{cases} 2.8\times10^{-4}\cdot D_j \cdot u/s & ; \quad EFF \leq 1 \\ 1 & ; \quad EFF > 1 \end{cases} \qquad (3\text{-}8)$$

where

u = impaction velocity in meters per second ($m\ s^{-1}$)

D_j = drop diameter for the j^{th} drop-size category in micrometers (μm)

s = diameter in centimeters of the element on which the drop impacts (input as a negative value in COLEFF)

If this array is omitted from the input data, the program will default to a vegetative element size of 13 centimeters by setting the array equal to all values of -13.

TREENV — Tree Envelope -- This parameter is an array specifying the width of the tree height class in meters (m) at each meter of tree height. Values are input in ascending order of the height of the tree class, beginning at one meter. There are exactly HGTCAN(J) values input for each canopy class J. The first HGTCAN(1) values are for height category 1, the second HGTCAN(2) values are for height category 2 and the last HGTCAN(3) values are for height category 3.

Dispersion Model Input Data. These parameters are used in the calculation of dosage, concentration and/or deposition and are required by the program only if ISW(4) is equal to "1".

Parameter Name	
NSOURC	Number of Line Sources -- This parameter specifies the number of line sources or aircraft spray lines to be used. The program is capable of processing a maximum of 100 line sources. If this value is input as "0" or omitted from the input data, the program defaults to a value of "1".
NXPNTS	Number of X (East-West) Receptor Coordinates -- This parameter specifies the number of X (east-west) receptor coordinates in the rectangular receptor grid system. The maximum number of X receptors depends on the values of NYPNTS and NXYPNT and is limited by $0 < NXPNTS+NYPNTS+2*NXYPNT \leq 100$ and and (3-9) $0 < NXPNTS*NYPNTS+NXYPNT \leq 737$
NYPNTS	Number of Y (North-South) Receptor Coordinates -- This param-parameter specifies the number of Y, (north-south) receptor coordinates in the rectangular receptor grid system. The maximum number of Y receptors is given by Equation (3-9).
NXYPNT	Number of X,Y Discrete (Arbitrarily Placed) Receptor Coordinates -- This parameter specifies the number of X,Y discrete receptor coordinates. The maximum number of discrete coordinates is given by Equation (3-9).
Q	Emission Rate -- This parameter specifies the spray emission rate for the line sources in units of grams per meter, or gallons per acre, depending on the input parameter SWATH. If the parameter SWATH is greater than zero,

Parameter Name	
Q (Cont.)	the program assumes Q is in gallons per acre and the area sprayed is sprayed in lines of an equal distance (SWATH) apart. If the spray lines are not uniform or the area is not regular, input Q in units of grams per meter and set the parameter SWATH equal to "0" or omit SWATH from the input data. If the parameter Q is input as "0" or omitted from the input data, the program defaults to a value of "1". The equation used to convert gallons per acre to grams per meter is given by

$$Q(g/m) = .9352938(acre \cdot cm^3/gal \cdot m^2) \cdot DENLIQ(g/cm^3) \cdot SWATH(m) \cdot Q(gal/acre)$$

where

DENLIQ = input liquid density

SWATH = input swath width

Q = input emission rate (gal/acre)

SWATH	Distance Between Spray Lines -- This parameter specifies the distance between uniform spray lines in meters. If the input of units of Q are in gallons per acre, then SWATH must be input as a value greater than zero. However, if the input units of Q are grams per meter then SWATH must be input as "0" or omitted from the input data.
Z	Height of Calculations -- This parameter specifies the height above ground in meters at which the calculations of dosage, concentration and deposition are to be performed. The FSCBG program at present does not have the capability to calculate dosage or concentration below the canopy

Parameter Name	
Z (Cont.)	height. However, deposition can be calculated at any height below the mixing depth HM. If this parameter is set to a value of "0" or omitted from the input data, the program assumes ground-level calculations are to be made.
SIGAP	Standard Deviation of the Wind Azimuth Angle -- This parameter specifies the standard deviation of the wind azimuth angle in units of radians or degrees. If the value input is greater than or equal to "1", the program assumes the value is in degrees. If the value input is less than "1", the program assumes the value is in radians.
SIGEP	Standard Deviation of the Wind Elevation Angle -- This parameter specifies the standard deviation of the wind elevation angle in units of radians or degrees. If the value input is greater than or equal to "1", the program assumes the value is in degrees. If the value input is less than "1", the program assumes the value is in radians.
TAU	Time to Cloud Stabilization -- This parameter specifies the time to spray cloud stabilization in seconds. If this parameter is input as "0" or omitted from the input data, the program defaults TAU to 2.5 seconds.
TAUO	Measurement Time for SIGAP -- This parameter specifies the averaging time for the standard deviation of the wind azimuth angle in seconds. If this parameter is input as "0" or omitted from the input data, the program defaults TAUO to 600 seconds.

Parameter Name	
SIGXYZ	Standard Deviation of the Spray Material Distribution -- This parameter specifies the standard deviation of the spray material distribution along the spray line in units of meters. If this parameter is input as "0" or omitted from the input data, the program defaults SIGXYZ to WNGSPN/4.3.
XLRZ	Lateral/Vertical Reference Distance -- This parameter specifies the lateral and vertical reference distance in meters downwind from the spray line where the spray cloud has dimensions given by SIGXYZ. This parameter is normally calculated by the FSCBG program. However, if XLRZ is input greater than or equal to zero, the input value is used.
DELU	Wind Speed-Shear -- This parameter specifies the wind speed shear between the canopy and the aircraft height in meters per second. The default for this parameter is "0".
HM	Surface Mixing Layer Height -- This parameter specifies the height of the surface mixing layer in meters.
THETA	Wind Direction -- This parameter specifies the wind direction (direction from which wind is blowing) in degrees, measured clockwise from 0 degrees (north).
DAREA	Area Assignment for Discrete Receptors -- This parameter specifies the area assignment in square meters to be used in the calculation of area-coverage for discrete receptors. If this parameter is set equal to "0" or omitted from

Parameter Name	
DAREA (Cont.)	the input data, the program defaults DAREA to 10000 square meters (1 hectare).
BETA1	Ratio of Lagrangian to Eulerian Time-Scales - This parameter specifies the ratio of Lagrangian to Eulerian time-scales to be used in the calculation of the correction factor for SIGEP and SIGAP for crossing-trajectory effects of heavy drops when evaporation is not occurring. If this parameter is set equal to "0" or omitted from the input data, no correction factor is applied. Normally a value of "1" is input for the application of this correction factor. The equations used in the correction factor are given by

$$\text{SIGEPR} = \begin{cases} \text{SIGEP}/\left[1+\left(\text{BETA1}\cdot V_s/\left(\text{WSOCAN}\cdot\text{SIGEP}\right)\right)^2\right]^{.25} & \text{; if BETA1} > 0 \;\&\; V_s/(\text{SIGEP}\cdot\text{WSOCAN}) > .2386 \\ & \quad \text{(non-evaporation only)} \\ \text{SIGEP} & \text{; if BETA1} = 0 \text{ or } V_s/(\text{SIGEP}\cdot\text{WSOCAN}) \leq .2386 \end{cases} \tag{3-11}$$

Parameter
Name

$$\text{SIGAPR} = \begin{cases} \text{SIGAP}/\left[1+4\cdot\left(\text{BETA1}\cdot V_s/\left(\text{WSOCAN}\cdot\text{SIGEP}\right)\right)^2\right]^{.25} & \text{; if BETA1} > 0 \ \& \\ & \quad (\text{SIGEP}\cdot\text{WSOCAN}) > .2386 \\ & \quad \text{(non-evaporation only)} \\ \text{SIGAP} & \text{; of BETA1} = 0 \text{ or} \\ & \quad \text{VS}/(\text{SIGEP}\cdot\text{WSOCAN}) \leq .2386 \end{cases} \tag{3-12}$$

X — Receptor X (East-West) Coordinates -- This parameter is an array specifying the values of the X axis of the rectangular grid system and discrete receptor coordinates in meters. The first NXPNTS values input to this array comprise the X axis of the grid system and are input in ascending (negative to positive) order of value. These values are immediately followed by NXYPNT values giving the X coordinates of the discrete (arbitrarily placed) receptors. The negative X axis is west (270 degrees) and the positive X axis is east (90 degrees).

Y — Receptor Y (North-South) Coordinates -- This parameter is an array specifying the values of the Y axis of the rectangular grid system and discrete receptor coordinates in meters. The first NYPNTS values input to this array comprise the Y axis of the grid system and are input in ascending (negative to positive) order of value. These values are immediately followed by NXYPNT values giving the Y coordinates

Parameter Name

GAMA, GAMB & GAMC (Cont.)

$$j = \begin{cases} 1 \; ; & \text{if } V_s \geq \text{VSGAM(1)} \\ 2 \; ; & \text{if } V_s \geq \text{VSGAM(2)} \;\&\; V_s < \text{VSGAM(1)} \\ 3 \; ; & \text{if } V_s < \text{VSGAM(2)} \end{cases}$$

Three coefficients of GAMA, GAMB and GAMC each are required. The first value of each array is for settling velocities greater than or equal to the paramter VSGAM(1). The second value of each array is for settling velocities less than VSGAM(1) and greater than or equal to VSGAM(2). The third value of each array is for settling velocities less than VSGAM(2). Default values for these arrays are provided only if the parameter is omitted from the input data. The default values are

GAMA(1) = 0.75 , GAMB(1) = - 2.5 , GAMC(1) = 0.0
GAMA(2) = 0.83465302, GAMB(2) = - 6.9031391, GAMC(2) = 57.409256
GAMA(3) = 0.91639996, GAMB(3) = -22.357124 , GAMC(3) = 821.42651

VSGAM

Settling Velocities for Fraction of Surface Reflection -- This array specifies two drop settling velocites in meters per second that break the curve of the fraction of material reflected at the surface given by GAMA, GAMB and GAMC into three parts. V_s values greater than or equal to VSGAM(1) use GAMA(1), GAMB(1) and GAMC(1) to calculate the fraction of material reflected at the surface. V_s values less than VSGAM(1) but greater than or equal to VSGAM(2) use GAMA(2), GAMB(2) and GAMC(2) to calculate the fraction of material reflected at the surface. V_s values less than VSGAM(2) use GAMA(3), GAMB(3) and GAMC(3). Default values for VSGAM are provided only if VSGAM is omitted from the input data. The default values are

VSGAM(1) = 0.04 , VSGAM(2) = 0.012

Parameter Name	
Y (Cont.)	of the discrete (arbitrarily placed) receptors. The negative Y axis is south (180 degrees) and the positive Y axis is north (0 degrees).
DX	Source X (East-West) Coordinates -- This parameter is an array specifying the start and end X coordinate of each line source in meters. Input the start followed by the end X coordinate for each source. Either end of the line may be the start coordinate.
DY	Source Y (North-South) Coordinates -- This parameter is an array specifying the start and end Y coordinate of each line source in meters. Input the start followed by the end Y coordinate for each source.
PCTMAT	Fraction of Total Material -- This parameter is an array specifying the fraction of the total spray material in each drop-size category. Input these values in descending order of drop-size categories.
GAMA, GAMB & GAMC	Coefficients of the Equation of the Fraction of Surface Reflection -- These three arrays specify the coefficients of the equation giving the fraction of material reflected at the surface as a function of the drop settling velocity

$$R = GAMA_j + GAMB_j \cdot V_s + GAMC_j \cdot V_s^2 \qquad (3\text{-}13)$$

where

V_s = drop settling velocity in meters per second

Parameter Name	
DOSLV	Dosage Area-Coverage -- This parameter is an array specifying the dosage levels in output dosage units for which dosage area-coverage is to be calculated. This array is not used by the program if either ISW(6) or ISW(12) are equal to "0". There are a maximum of 10 values possible.
CONLV	Concentration Area-Coverage -- This parameter is an array specifying the concentration levels in output concentration units for which concentration area-coverage is to be calculated. This array is not used by the program if either ISW(7) or ISW(12) are equal to "0". There are a maximum of 10 values possible.
DEPLV	Deposition Area-Coverage -- This parameter is an array specifying the deposition levels in output deposition units for which deposition area-coverage is to be calculated. This array is not used by the program if either ISW(8) or ISW(12) are equal to "0". There are a maximum of 10 values possible.

3.1.3 Output Information

The FSCBG program generates four categories of print output. Each category, except the first, is optional to the user. In the following paragraphs, each category of output is related to the specific input parameter or parameters that control the output category. All program output is printed.

Input Parameter Output. The first page of output produced by the FSCBG program is a listing of all input data read by the program. An example listing of this table is shown in Figure 3-1. Note that input parameters that have been omitted and are to be calculated by the program are shown as * symbols. A similar listing on a different computer might show $ symbols

```
                                                    TABLE  1
                                              - PROGRAM INPUT DATA -
                                        (NOTE - ******* MEANS NOT APPLICABLE)

     *** INPUTS USED BY ALL MODELS ***
PROGRAM OPTIONS, (ISW) = 1 1 2 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
IS LIQUID WATER OR NON-WATER, 2=NON-WATER, 1=WATER, (IFWATR) = 1
AIRCRAFT WING SPAN (WNGSPN (METERS)) =  11.48
WIND SPEED ABOVE CANOPY (WSOCAN (M/S)) = 1.020
HEIGHT OF AIRCRAFT (HGTCFT (METERS)) =  18.10
DENSITY OF SPRAY LIQUID (DENLIQ (G/CM**3)) =   1.0000
AIR TEMPERATURE ABOVE THE CANOPY (AIRTPO (DEG C)) = 14.400
AIR TEMPERATURE BELOW THE CANOPY (AIRTPU (DEG C)) = 14.400
AIR DENSITY (AIRDEN (G/CM**3)) **********
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
BAROMETRIC PRESSURE (AIRPRS (MB)) =1013.25
VAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) ********
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
     *** INPUTS USED BY THE WAKE SETTLING VELOCITY MODEL ***
AIRCRAFT WEIGHT (ARCRWT (KG)) = 1406.000
AIRCRAFT GROUND SPEED (ARCRSP (M/S)) =  40.200
     *** INPUTS USED BY THE EVAPORATION MODEL ***
UPPER LIMITS OF DROP DIAMETERS (DRPUPR (MICRO-M)) =
1420.000,1020.000, 840.000, 742.000, 667.000, 577.000, 514.000,
 456.000, 351.000, 302.000, 253.000, 200.000, 169.000, 135.000,
 100.000,  51.600,
LOWER LIMITS OF DROP DIAMETERS (DRPLWR (MICRO-M)) =
1020.000, 840.000, 742.000, 667.000, 577.000, 514.000, 456.000,
 351.000, 302.000, 253.000, 200.000, 169.000, 135.000, 100.000,
  51.600,  20.000,
BAROMETRIC PRESSURE (AIRPRS (MB)) =1013.25
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
MOLECULAR WEIGHT OF EVAPORATING VAPOR (VAPMOL) = 18.0150
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
```


FIGURE 3-1. FSCBG Program Input Data Listing

TABLE 1 (CONT.)
- PROGRAM INPUT DATA -
(NOTE - ******* MEANS NOT APPLICABLE)

```
      *** INPUTS USED BY THE CANOPY PENETRATION MODEL ***
 WIND SPEED IN BOTTOM QUARTER OF CANOPY (WSIN14 (M/S)) =   .950
 WIND SPEED IN SECOND QUARTER OF CANOPY (WSIN24 (M/S)) =   .840
 WIND SPEED IN THIRD QUARTER OF CANOPY (WSIN34 (M/S)) =   .820
 WIND SPEED IN TOP QUARTER OF CANOPY (WSIN44 (M/S)) =   .900
 HEIGHT OF CANOPY (HGTCAN (METERS)) = 12.00,    .00,    .00,
 PROBABILITY OF PENETRATION (PRBPEN) = .380, .000, .000,
 TREE DENSITY (TREDEN (TREES/ACRE)) =  96.80,     .00,     .00,
 DIAMETER OF VEGETATIVE ELEMENTS (COLEFF (CM)) = 13.00, 13.00, 13.00,
 TREE WIDTH FROM BOTTOM TO TOP FOR FOREST CLASS 1 (TREENV (M)) =
    .210,   .190,   .190, 3.800, 6.600, 6.200, 5.800, 6.400, 5.000,
  4.000, 3.300, 1.600,
```


FIGURE 3-1. (Continued)

TABLE 1 (CONT.)
- PROGRAM INPUT DATA -
(NOTE - ******* MEANS NOT APPLICABLE)

```
     *** INPUTS USED BY THE DISPERSION MODELS ***
NUMBER OF LINE SOURCES (NSOURC) =   7
NUMBER OF RECEPTORS IN GRID SYSTEM X AXIS (NXPNTS) =  51
NUMBER OF RECEPTORS IN GRID SYSTEM Y AXIS (NYPNTS) =   1
NUMBER OF DISCRETE RECEPTORS (NXYPNT) =   0
EMISSION OF SPRAY MATERIAL (Q (GRAMS/M)) = .573300+002
HEIGHT OF DISPERSION MODELS CALCULATION (Z (M)) =     .00
STANDARD DEV. OF WIND DIRECTION ANGLE (SIGAP (RAD)) = .24609
STANDARD DEV. OF WIND ELEVATION ANGLE (SIGEP (RAD)) = .20420
TIME TO SPRAY CLOUD STABILIZATION (TAU (SEC)) =   2.500
MEASUREMENT TIME FOR SIGAP (TAUD (SEC)) = 600.000
STAND. DEV. OF SPRAY MATERIAL ALONG SPRAY LINE (SIGXYZ (M)))=   4.000
DECAY COEFFICIENT (DECAY (/SEC)) = .000000
LAT., VERT. REFERENCE DISTANCE (XLRZ (M)) =**********
SURFACE MIXING LAYER HEIGHT (HM (M)) = 1000.000
WIND DIRECTION (FROM) (THETA (DEG)) =  23.00
AREA ASSIGNMENT FOR DISCRETE RECEPTORS (DAREA (M**2)) =    10000.00
RATIO OF LAGRANGIAN TO EULERIAN TIME SCALES (BETA1) =   .00
WIND-SPEED SHEAR (DELU (M/S)) =   .0000
X AXIS OF RECEPTOR GRID SYSTEM (X (M)) =     -82.3,     -81.4,
     -80.5,     -79.6,     -78.6,     -77.7,     -76.8,     -75.9,
     -75.0,     -74.1,     -73.2,     -72.2,     -71.3,     -70.4,
     -69.5,     -68.6,     -67.7,     -66.8,     -65.8,     -64.9,
     -64.0,     -63.1,     -62.2,     -61.3,     -60.4,     -59.4,
     -58.5,     -57.6,     -56.7,     -55.8,     -54.9,     -53.9,
     -53.0,     -52.1,     -51.2,     -50.3,     -49.4,     -48.5,
     -47.5,     -46.6,     -45.7,     -44.8,     -43.9,     -43.0,
     -42.1,     -41.1,     -40.2,     -39.3,     -38.4,     -37.5,
     -36.6,
Y AXIS OF RECEPTOR GRID SYSTEM (Y (M)) =     153.2,
START AND END X COORDINATES OF LINE SOURCES (DX (M)) =
     -86.9,     -86.9,     -77.7,     -77.7,     -68.6,     -68.6,
     -59.4,     -59.4,     -50.3,     -50.3,     -41.1,     -41.1,
     -32.0,     -32.0,
START AND END Y COORDINATES OF LINE SOURCES (DY (M)) =
     370.3,    -384.3,     370.3,    -384.3,     370.3,    -384.3,
     370.3,    -384.3,     370.3,    -384.3,     370.3,    -384.3,
     370.3,    -384.3,
FRACTION OF SPRAY MATERIAL FOR EACH DROP CAT. (PCTMAT) = .01000,
  .02000,  .03000,  .04000,  .10000,  .10000,  .10000,  .20000,   10000,
  .10000,  .10000,  .04000,  .03000,  .02000,  .00900,  .00100,
SETTLING VEL. SPECIFYING WHICH SET OF GAMA, GAMB AND GAMC TO
USE (VSGAM (M S)) =   .0400,   .0120
COEFFICIENTS OF EQUATIONS GIVING SURF. REFLECT. COEFFS. (GAMA,GAMB,GAMC) =
  .750000+000,  .834653+000,  .916400+000,-.250000+001,-.690314+001,
-.223571+002,  .000000     ,  .574093+002,  .821427+003,
```

FIGURE 3-1. (Continued)

rather than * symbols. Figure 3-1 consists of three pages of program output. The first page shows the parameters used by all program models, those used by the wake-settling velocity model and those used by the evaporation model. The second page of this table shows the parameters used by the canopy penetration model and the third page shows those used by the dispersion models.

Evaporation Model Output. This output is controlled by the parameter ISW(5). The user has the option of not printing (ISW(5)="0" or printing the results of these calculations (ISW(5)="1"). An example output listing produced by ISW(5) equal to "1" is shown in Figure 3-2. The first page of Figure 3-2 shows calculated parameters used by the evaporation model that are primarily of theoretical interest. The second page shows a detail of the above canopy evaporation for drop size category 1. The listing gives the height of the drop, the maximum, mean and minimum size, the total mass loss due to evaporation, the mass loss in the height interval due to evaporation, the travel time, the horizontal distance, the settling velocity and the percent of the material reaching the indicated height as drops. Following the evaporation detail for drop-size category 1, the program prints the coefficients for the equations of settling velocity as a function of distance, height as a function of distance, fraction of drops as a function of height, time as a function of height and drop size as a function of time. The evaporation detail and following equation coefficients are repeated for each drop-size category, largest to smallest. The program then prints the same information for each drop-size category below the canopy. The last three pages of Figure 3-2 show the evaporation detail below the canopy for drop size category 1. If the drop-size category evaporates prior to reaching the canopy the program will print a "DROP EVAPORATED" message for the below canopy evaporation detail.

Canopy Penetration Model Output. This output is controlled by the parameter ISW(3). The user can elect either not to print (ISW(3)="0") or to print ISW(3)="1") the results of these calculations. An example output listing produced by ISW(3) equal to "1" is shown in Figure 3-3. The canopy

TABLE 2
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
AIR DENSITY = .12200585-002 (G/CM**3)
MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .53880651-004 (CAL/(SEC.CM.DEGREE K))
LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
DROP PRESSURE = .16340134+002 (MB)
DROP TEMPERATURE = .14290404+002 (DEGREES C)
WAKE SETTLING VELOCITY = .54999816+000 (M/S)
ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
SCHMIDT NUMBER = .43981910+000

FIGURE 3-2. Evaporation Model Calculations Listing

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
18.100	1420.000	1230.992	1020.000	.0000	.0000	.000	.00	4.9376646	100.000
17.798	1419.999	1230.990	1019.998	.3444-008	.3444-008	.061	.06	4.9376601	100.000
17.497	1419.997	1230.989	1019.997	.6850-008	.3406-008	.122	.12	4.9376557	99.999
17.195	1419.996	1230.988	1019.995	.1029-007	.3436-008	.183	.19	4.9376512	99.999
16.893	1419.994	1230.986	1019.994	.1370-007	.3413-008	.244	.25	4.9376467	99.999
16.592	1419.993	1230.985	1019.992	.1714-007	.3436-008	.305	.31	4.9376423	99.998
16.290	1419.992	1230.983	1019.991	.2053-007	.3391-008	.367	.37	4.9376379	99.998
15.988	1419.990	1230.982	1019.989	.2396-007	.3436-008	.428	.44	4.9376335	99.998
15.687	1419.989	1230.980	1019.988	.2741-007	.3444-008	.489	.50	4.9376289	99.997
15.385	1419.987	1230.979	1019.986	.3081-007	.3406-008	.550	.56	4.9376246	99.997
15.083	1419.986	1230.977	1019.985	.3425-007	.3436-008	.611	.62	4.9376200	99.996
14.782	1419.985	1230.976	1019.983	.3767-007	.3421-008	.672	.69	4.9376156	99.996
14.480	1419.983	1230.975	1019.982	.4108-007	.3406-008	.733	.75	4.9376112	99.996
14.178	1419.982	1230.973	1019.980	.4451-007	.3436-008	.794	.81	4.9376068	99.995
13.877	1419.980	1230.972	1019.979	.4793-007	.3413-008	.855	.87	4.9376023	99.995
13.575	1419.979	1230.970	1019.977	.5135-007	.3421-008	.916	.93	4.9375979	99.995
13.273	1419.978	1230.969	1019.976	.5478-007	.3429-008	.978	1.00	4.9375935	99.994
12.972	1419.976	1230.967	1019.974	.5821-007	.3436-008	1.039	1.06	4.9375890	99.994
12.670	1419.975	1230.966	1019.973	.6163-007	.3421-008	1.100	1.12	4.9375845	99.994
12.368	1419.973	1230.965	1019.971	.6506-007	.3429-008	1.161	1.18	4.9375801	99.993
12.067	1419.972	1230.963	1019.970	.6848-007	.3413-008	1.222	1.25	4.9375756	99.993
11.765	1419.971	1230.962	1019.968	.7192-007	.3444-008	1.283	1.31	4.9375711	99.993
11.463	1419.969	1230.960	1019.967	.7533-007	.3406-008	1.344	1.37	4.9375668	99.992
11.162	1419.968	1230.959	1019.965	.7874-007	.3413-008	1.405	1.43	4.9375623	99.992
10.860	1419.966	1230.957	1019.964	.8215-007	.3413-008	1.466	1.50	4.9375578	99.992
10.558	1419.965	1230.956	1019.962	.8560-007	.3444-008	1.527	1.56	4.9375534	99.991
10.257	1419.964	1230.954	1019.961	.8900-007	.3406-008	1.588	1.62	4.9375490	99.991
9.955	1419.962	1230.953	1019.959	.9244-007	.3436-008	1.650	1.68	4.9375445	99.991
9.653	1419.961	1230.952	1019.957	.9588-007	.3444-008	1.711	1.74	4.9375400	99.990
9.352	1419.959	1230.950	1019.956	.9929-007	.3406-008	1.772	1.81	4.9375356	99.990
9.050	1419.958	1230.949	1019.954	.1027-006	.3413-008	1.833	1.87	4.9375312	99.989
8.748	1419.957	1230.947	1019.953	.1061-006	.3436-008	1.894	1.93	4.9375267	99.989
8.447	1419.955	1230.946	1019.951	.1096-006	.3413-008	1.955	1.99	4.9375222	99.989
8.145	1419.954	1230.944	1019.950	.1130-006	.3436-008	2.016	2.06	4.9375178	99.988
7.843	1419.952	1230.943	1019.948	.1164-006	.3413-008	2.077	2.12	4.9375134	99.988
7.542	1419.951	1230.941	1019.947	.1198-006	.3436-008	2.138	2.18	4.9375089	99.988
7.240	1419.950	1230.940	1019.945	.1233-006	.3413-008	2.199	2.24	4.9375045	99.987
6.938	1419.948	1230.939	1019.944	.1267-006	.3413-008	2.261	2.31	4.9375000	99.987
6.637	1419.947	1230.937	1019.942	.1301-006	.3421-008	2.322	2.37	4.9374956	99.987
6.335	1419.945	1230.936	1019.941	.1335-006	.3452-008	2.383	2.43	4.9374911	99.986
6.033	1419.944	1230.934	1019.939	.1369-006	.3391-008	2.444	2.49	4.9374867	99.986
5.732	1419.943	1230.933	1019.938	.1404-006	.3436-008	2.505	2.56	4.9374823	99.986
5.430	1419.941	1230.931	1019.936	.1438-006	.3413-008	2.566	2.62	4.9374778	99.985

FIGURE 3-2. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
5.128	1419.940	1230.930	1019.935	.1472-006	.3436-008	2.627	2.68	4.9374734	99.985
4.827	1419.939	1230.929	1019.933	.1506-006	.3413-008	2.688	2.74	4.9374689	99.985
4.525	1419.937	1230.927	1019.932	.1541-006	.3436-008	2.749	2.80	4.9374645	99.984
4.223	1419.936	1230.926	1019.930	.1575-006	.3413-008	2.810	2.87	4.9374600	99.984
3.922	1419.934	1230.924	1019.929	.1609-006	.3436-008	2.872	2.93	4.9374556	99.984
3.620	1419.933	1230.923	1019.927	.1643-006	.3406-008	2.933	2.99	4.9374511	99.983
3.318	1419.932	1230.921	1019.926	.1678-006	.3444-008	2.994	3.05	4.9374467	99.983
3.017	1419.930	1230.920	1019.924	.1712-006	.3413-008	3.055	3.12	4.9374422	99.982
2.715	1419.929	1230.919	1019.923	.1746-006	.3406-008	3.116	3.18	4.9374378	99.982
2.413	1419.927	1230.917	1019.921	.1780-006	.3444-008	3.177	3.24	4.9374334	99.982
2.112	1419.926	1230.916	1019.920	.1814-006	.3413-008	3.238	3.30	4.9374289	99.981
1.810	1419.925	1230.914	1019.918	.1849-006	.3429-008	3.299	3.37	4.9374244	99.981
1.508	1419.923	1230.913	1019.917	.1883-006	.3436-008	3.360	3.43	4.9374200	99.981
1.207	1419.922	1230.911	1019.915	.1917-006	.3421-008	3.421	3.49	4.9374155	99.980
.905	1419.920	1230.910	1019.913	.1952-006	.3429-008	3.482	3.55	4.9374111	99.980
.603	1419.919	1230.908	1019.912	.1986-006	.3413-008	3.544	3.61	4.9374066	99.980
.302	1419.918	1230.907	1019.910	.2020-006	.3421-008	3.605	3.68	4.9374022	99.979
.000	1419.916	1230.906	1019.909	.2054-006	.3406-008	3.666	3.74	4.9373978	99.979
-.302	1419.915	1230.904	1019.907	.2088-006	.3436-008	3.727	3.80	4.9373933	99.979
-1.098	1419.911	1230.900	1019.903	.2179-006	.1253-007	3.888	3.97	4.9373815	99.978
-2.245	1419.906	1230.895	1019.898	.2310-006	.1804-007	4.120	4.20	4.9373645	99.976
-3.896	1419.898	1230.887	1019.889	.2498-006	.2596-007	4.455	4.54	4.9373401	99.974
-6.274	1419.887	1230.875	1019.877	.2770-006	.3743-007	4.937	5.04	4.9373048	99.972
-9.699	1419.871	1230.859	1019.860	.3161-006	.5390-007	5.630	5.74	4.9372541	99.968
-14.630	1419.848	1230.835	1019.835	.3724-006	.7762-007	6.629	6.76	4.9371809	99.962
-21.730	1419.814	1230.801	1019.799	.4535-006	.1118-006	8.067	8.23	4.9370755	99.954
-31.956	1419.767	1230.752	1019.748	.5703-006	.1611-006	10.138	10.34	4.9369237	99.942
-46.680	1419.698	1230.681	1019.674	.7385-006	.2320-006	13.121	13.38	4.9367052	99.924
-67.882	1419.598	1230.580	1019.567	.9808-006	.3340-006	17.416	17.76	4.9363903	99.900
-98.414	1419.455	1230.433	1019.413	.1330-005	.4809-006	23.601	24.07	4.9359370	99.864
-142.380	1419.249	1230.222	1019.191	.1832-005	.6924-006	32.509	33.16	4.9352840	99.812
-205.691	1418.952	1229.918	1018.871	.2555-005	.9970-006	45.337	46.24	4.9343435	99.738
-296.859	1418.525	1229.479	1018.411	.3596-005	.1435-005	63.815	65.09	4.9329887	99.632
-428.141	1417.909	1228.848	1017.748	.5094-005	.2066-005	90.430	92.24	4.9310368	99.478
-617.187	1417.022	1227.939	1016.793	.7249-005	.2973-005	128.774	131.35	4.9282241	99.258
-889.412	1415.743	1226.628	1015.416	.1035-004	.4277-005	184.023	187.70	4.9241696	98.940
-1281.418	1413.900	1224.738	1013.431	.1481-004	.6150-005	263.655	268.93	4.9183226	98.484
-1845.905	1411.242	1222.013	1010.567	.2122-004	.8839-005	378.476	386.05	4.9098852	97.828
-2880.045	1406.358	1217.006	1005.306	.3291-004	.1170-004	589.267	601.05	4.8943759	96.630
-3905.953	1401.495	1212.019	1000.063	.4447-004	.1155-004	799.042	815.02	4.8789136	95.447
-5429.520	1394.238	1204.576	992.234	.6154-004	.1707-004	1111.811	1134.05	4.8558078	93.700
-6934.923	1387.026	1197.177	984.447	.7830-004	.1676-004	1422.322	1450.77	4.8328068	91.984
-8914.237	1377.478	1187.382	974.130	.1002-003	.2187-004	1832.851	1869.51	4.8023037	89.744

FIGURE 3-2. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	DROP DIAMETER AVERAGE (MICRO-M)	DROP DIAMETER MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	MASS LOST DUE TO EVAPORATION IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
-10378.080	1370.368	1180.087	966.443	.1162-003	.1606-004	2138.154	2180.92	4.7795514	98.100

FIGURE 3-2. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- CALCULATED EQUATIONS FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

SETTLING VELOCITY AS A FUNCTION OF DISTANCE
VS(MPS) = .49376656+001 + -.71841217-004 *X+ -.30143473-009 *X**2

HEIGHT AS A FUNCTION OF DISTANCE
H(M) = .18119107+002 + -.48426686+001 *X+ .34569162-004 *X**2

FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
FRACT = .99978900+000 + .11697134-004 *H+ .24207153-010 *H**2

TIME AS A FUNCTION OF HEIGHT
TIME(SEC) = .36692189+001 + -.20243053+000 *H+ .30951647-006 *H**2

DROP DIAMETER AS A FUNCTION OF TIME
DROP(MICRO-M) = .12309922+004 + -.23706743-001 *T+ -.47505991-007 *T**2

FIGURE 3-2. (Continued)

TABLE 3
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

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VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
AIR DENSITY =  12200585-002 (G/CM**3)
MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .59880651-004 (CAL/(SEC.CM.DEGREE K))
LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
DROP PRESSURE = .16340134+002 (MB)
DROP TEMPERATURE = .14290404+002 (DEGREES C)
WAKE SETTLING VELOCITY = .54999816+000 (M/S)
ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
SCHMIDT NUMBER = .43981910+000
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FIGURE 3-2. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
12.000	1419.972	1230.963	1019.970	.6848-007	.0000	1.222	1.25	4.9375756	99.993
11.800	1419.971	1230.962	1019.969	.7076-007	.2286-008	1.262	1.28	4.9375727	99.993
11.600	1419.970	1230.961	1019.968	.7305-007	.2286-008	1.303	1.32	4.9375696	99.993
11.400	1419.969	1230.960	1019.967	.7533-007	.2278-008	1.343	1.36	4.9375667	99.992
11.200	1419.968	1230.959	1019.966	.7761-007	.2286-008	1.384	1.39	4.9375637	99.992
11.000	1419.967	1230.958	1019.965	.7987-007	.2263-008	1.424	1.43	4.9375607	99.992
10.800	1419.966	1230.957	1019.964	.8215-007	.2278-008	1.465	1.47	4.9375578	99.992
10.600	1419.965	1230.956	1019.963	.8441-007	.2263-008	1.505	1.50	4.9375549	99.991
10.400	1419.965	1230.955	1019.962	.8669-007	.2278-008	1.546	1.54	4.9375520	99.991
10.200	1419.964	1230.954	1019.961	.8898-007	.2286-008	1.586	1.57	4.9375490	99.991
10.000	1419.963	1230.954	1019.960	.9124-007	.2263-008	1.627	1.61	4.9375460	99.991
9.800	1419.962	1230.953	1019.959	.9353-007	.2286-008	1.667	1.65	4.9375430	99.990
9.600	1419.961	1230.952	1019.958	.9579-007	.2263-008	1.708	1.68	4.9375402	99.990
9.400	1419.960	1230.951	1019.957	.9808-007	.2286-008	1.748	1.72	4.9375371	99.990
9.200	1419.959	1230.950	1019.956	.1003-006	.2271-008	1.789	1.76	4.9375342	99.990
9.000	1419.958	1230.949	1019.955	.1026-006	.2263-008	1.829	1.79	4.9375312	99.989
8.800	1419.957	1230.948	1019.954	.1049-006	.2286-008	1.870	1.83	4.9375283	99.989
8.600	1419.956	1230.947	1019.953	.1072-006	.2286-008	1.911	1.86	4.9375253	99.989
8.400	1419.955	1230.946	1019.952	.1094-006	.2263-008	1.951	1.89	4.9375224	99.989
8.200	1419.954	1230.945	1019.951	.1117-006	.2278-008	1.992	1.93	4.9375194	99.989
8.000	1419.953	1230.944	1019.950	.1140-006	.2286-008	2.032	1.96	4.9375165	99.988
7.800	1419.952	1230.943	1019.949	.1163-006	.2278-008	2.073	1.99	4.9375135	99.988
7.600	1419.952	1230.942	1019.947	.1185-006	.2263-008	2.113	2.03	4.9375106	99.988
7.400	1419.951	1230.941	1019.946	.1208-006	.2263-008	2.154	2.06	4.9375076	99.988
7.200	1419.950	1230.940	1019.945	.1231-006	.2286-008	2.194	2.09	4.9375046	99.987
7.000	1419.949	1230.939	1019.944	.1254-006	.2278-008	2.235	2.13	4.9375017	99.987
6.800	1419.948	1230.938	1019.943	.1276-006	.2263-008	2.275	2.16	4.9374987	99.987
6.600	1419.947	1230.937	1019.942	.1299-006	.2286-008	2.316	2.19	4.9374958	99.987
6.400	1419.946	1230.936	1019.941	.1322-006	.2286-008	2.356	2.22	4.9374928	99.986
6.200	1419.945	1230.935	1019.940	.1345-006	.2278-008	2.397	2.26	4.9374899	99.986
6.000	1419.944	1230.934	1019.939	.1367-006	.2255-008	2.437	2.29	4.9374869	99.986
5.800	1419.943	1230.933	1019.938	.1390-006	.2286-008	2.478	2.33	4.9374840	99.986
5.600	1419.942	1230.932	1019.937	.1413-006	.2286-008	2.518	2.36	4.9374810	99.986
5.400	1419.941	1230.932	1019.936	.1436-006	.2263-008	2.559	2.39	4.9374781	99.985
5.200	1419.940	1230.931	1019.935	.1459-006	.2286-008	2.599	2.43	4.9374751	99.985
5.000	1419.939	1230.930	1019.934	.1481-006	.2278-008	2.640	2.46	4.9374721	99.985
4.800	1419.938	1230.929	1019.933	.1504-006	.2263-008	2.680	2.50	4.9374692	99.985
4.600	1419.938	1230.928	1019.932	.1527-006	.2278-008	2.721	2.53	4.9374663	99.984
4.400	1419.937	1230.927	1019.931	.1550-006	.2286-008	2.761	2.56	4.9374633	99.984
4.200	1419.936	1230.926	1019.930	.1573-006	.2286-008	2.802	2.60	4.9374603	99.984
4.000	1419.935	1230.925	1019.929	.1595-006	.2255-008	2.842	2.63	4.9374574	99.984
3.800	1419.934	1230.924	1019.928	.1618-006	.2286-008	2.883	2.67	4.9374544	99.983
3.600	1419.933	1230.923	1019.927	.1641-006	.2263-008	2.923	2.70	4.9374514	99.983

FIGURE 3-2. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
3.400	1419.932	1230.922	1019.926	.1663-006	.2286-008	2.964	2.73	4.9374485	99.983
3.200	1419.931	1230.921	1019.925	.1686-006	.2255-008	3.004	2.77	4.9374455	99.983
3.000	1419.930	1230.920	1019.924	.1709-006	.2278-008	3.045	2.80	4.9374425	99.982
2.800	1419.929	1230.919	1019.923	.1732-006	.2286-008	3.085	2.84	4.9374396	99.982
2.600	1419.928	1230.918	1019.922	.1755-006	.2286-008	3.126	2.88	4.9374366	99.982
2.400	1419.927	1230.917	1019.921	.1777-006	.2263-008	3.166	2.92	4.9374337	99.982
2.200	1419.926	1230.916	1019.920	.1800-006	.2286-008	3.207	2.96	4.9374307	99.982
2.000	1419.925	1230.915	1019.919	.1823-006	.2255-008	3.247	2.99	4.9374278	99.981
1.800	1419.925	1230.914	1019.918	.1845-006	.2286-008	3.288	3.03	4.9374248	99.981
1.600	1419.924	1230.913	1019.917	.1868-006	.2278-008	3.328	3.07	4.9374219	99.981
1.400	1419.923	1230.912	1019.916	.1891-006	.2263-008	3.369	3.11	4.9374190	99.981
1.200	1419.922	1230.911	1019.915	.1914-006	.2286-008	3.409	3.15	4.9374160	99.980
1.000	1419.921	1230.910	1019.914	.1936-006	.2278-008	3.450	3.19	4.9374130	99.980
.800	1419.920	1230.910	1019.913	.1959-006	.2286-008	3.490	3.23	4.9374101	99.980
.600	1419.919	1230.909	1019.912	.1982-006	.2263-008	3.531	3.26	4.9374072	99.980
.400	1419.918	1230.908	1019.911	.2005-006	.2286-008	3.571	3.30	4.9374042	99.979
.200	1419.917	1230.907	1019.910	.2028-006	.2278-008	3.612	3.34	4.9374012	99.979
.000	1419.916	1230.906	1019.909	.2050-006	.2255-008	3.652	3.38	4.9373983	99.979
-.200	1419.915	1230.905	1019.908	.2073-006	.2286-008	3.693	3.42	4.9373953	99.979

FIGURE 3-2. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- CALCULATED EQUATIONS FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

SETTLING VELOCITY AS A FUNCTION OF HEIGHT
VS(MPS) = .49373983+001 + .14773079-004 *H+ .11027818-009 *H**2

HEIGHT AS A FUNCTION OF DISTANCE
H(M) = .11926300+002 + -.59956063+001 *X+ .12372368+000 *X**2

DISTANCE AS A FUNCTION OF HEIGHT
X(M) = .20776707+001 + -.18199798+000 *H+ .65906207-003 *H**2

FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
FRACT = .99986250+000 + .11651691-004 *H+ -.14707762-009 *H**2

DROP DIAMETER AS A FUNCTION OF HEIGHT
DROP(MICROM) = .12309057+004 + .47817502-002 *H+ -.10877131-006 *H**2

DROP DIAMETER AS A FUNCTION OF TIME
DROP(MICROM) = .12309919+004 + -.23591295-001 *T+ -.24819962-005 *T**2

FIGURE 3-2. (Continued)

TABLE 4
- CALCULATED VALUES FROM CANOPY PENETRATION MODEL -

DROP SIZE CATEGORY	FRACTION/DISTANCE OF MATERIAL REACHING INDICATED HEIGHT											
	HGT= 12.0 M		HGT= 10.8 M		HGT= 9.6 M		HGT= 8.4 M		HGT= 7.2 M		HGT= 6.0 M	
	FRACT	/DIST(M)/	FRACT	/DIST(M)/	FRACT	/DIST(M)/	FRACT	/DIST(M)/	FRACT	/DIST(M)/	FRACT	/DIST(M)/
1	1.00000	.0	.69800	.2	.62600	.4	.52400	.6	.37200	.8	.37200	1.0
2	1.00000	.0	.72000	.2	.66800	.5	.57400	.8	.43600	1.0	.43600	1.3
3	1.00000	.0	.74400	.3	.69600	.6	.61200	.9	.44400	1.2	.44400	1.5
4	1.00000	.0	.73200	.3	.68400	.6	.60800	1.0	.47600	1.3	.47600	1.6
5	1.00000	.0	.67800	.4	.61400	.7	.54600	1.1	.41800	1.5	.41800	1.8
6	1.00000	.0	.80600	.4	.73400	.8	.64200	1.3	.51800	1.7	.51200	2.1
7	1.00000	.0	.81400	.5	.74600	1.0	.64400	1.4	.51400	1.9	.51200	2.4
8	1.00000	.0	.84200	.6	.79000	1.1	.67600	1.7	.51400	2.3	.47800	2.9
9	1.00000	.0	.88800	.7	.82000	1.4	.73400	2.1	.62200	2.8	.53400	3.5
10	1.00000	.0	.93200	.8	.86600	1.7	.78800	2.5	.67200	3.3	.55000	4.2
11	1.00000	.0	1.00000	1.1	.94000	2.1	.81400	3.2	.68600	4.3	.57800	5.5
12	1.00000	.0	.87800	1.3	.79000	2.7	.69200	4.0	.59400	5.4	.50400	6.8
13	1.00000	.0	.99200	1.7	.91200	3.4	.79400	5.1	.69600	6.8	.61000	8.5
14	1.00000	.0	.92200	2.5	.85000	5.0	.77200	7.5	.68400	10.0	.63000	12.6
15	1.00000	.0	.97200	4.7	.91800	9.4	.84800	14.2	.80000	19.2	.73600	24.1
16	1.00000	.0	.26000	64.2	.00000	220.4	.00000	468.6	.00000	808.8	.00000	1241.0

DROP SIZE CATEGORY	FRACTION/DISTANCE OF MATERIAL REACHING INDICATED HEIGHT									
	HGT= 4.8 M		HGT= 3.6 M		HGT= 2.4 M		HGT= 1.2 M		HGT= .0 M	
	FRACT	/DIST(M)/	FRACT	/DIST(M)/	FRACT	/DIST(M)/	FRACT	/DIST(M)/	FRACT	/DIST(M)/
1	.30600	1.2	.30600	1.4	.30600	1.7	.30600	1.9	.30600	2.1
2	.34800	1.5	.34800	1.8	.34800	2.1	.34800	2.3	.34800	2.6
3	.33800	1.8	.33800	2.1	.33800	2.4	.33800	2.7	.33800	3.0
4	.35400	2.0	.35400	2.3	.35400	2.6	.35400	3.0	.35400	3.3
5	.33000	2.2	.33000	2.6	.33000	3.0	.33000	3.4	.33000	3.8
6	.38800	2.6	.38800	3.0	.38800	3.5	.38800	3.9	.38800	4.4
7	.41000	2.9	.41000	3.4	.41000	3.9	.41000	4.5	.41000	5.0
8	.36800	3.5	.36800	4.1	.36800	4.7	.36800	5.3	.36800	5.9
9	.37400	4.2	.37400	4.9	.37400	5.7	.37400	6.4	.37400	7.2
10	.36800	5.1	.33000	5.9	.33000	6.8	.33000	7.7	.33000	8.6
11	.41400	6.6	.32400	7.7	.30800	8.9	.30800	10.0	.30800	11.2
12	.38600	8.2	.32400	9.6	.31000	11.0	.31000	12.5	.30800	13.9
13	.56200	10.3	.52400	12.1	.51800	13.9	.51800	15.7	.51800	17.5
14	.56600	15.2	.53800	17.8	.52800	20.5	.52800	23.2	.52800	25.9
15	.71000	29.2	.68000	34.3	.67600	39.5	.67600	44.8	.67600	50.2
16	.00000	1765.3	.00000	2381.6	.00000	3090.0	.00000	3890.3	.00000	4782.7

FIGURE 3-3. Canopy Penetration Model Calculations Listing

penetration model output gives the fraction of drop material that reaches each tenth of the forest canopy height and the horizontal distance from the point of entry to the given tenth of canopy height. This information is printed for each drop size category. If a drop-size category evaporates prior to entering the canopy, the fraction of drop material in the table will be zero.

Dispersion Model Output. This output is controlled by the parameter ISW(4). The user does not have the option of not printing these calculations. An example output listing produced by ISW(4) equal to "1" is shown in Figure 3-4. This figure shows a listing of the calculation of ground-level deposition. The listing gives the units, the maximum value and location of the maximum value followed by the deposition calculated at each receptor location. An output listing for dosage and/or concentration would have the same structure and content.

3.2 USER'S INSTRUCTIONS

3.2.1 Program Description

The FSCBG program is designed to calculate the wake-settling velocity of the spray aircraft, the evaporation of spray drops, the percentage of spray material penetrating to fixed levels within a forest canopy and dosage, concentration and deposition at specified receptor coordinates downwind of multiple spray lines. The FSCBG computer program is written in FORTRAN IV and is designed for use on a UNIVAC 1108 computer. The program requires approximately 24000 words of executable core for instruction and data storage on the UNIVAC 1108. The program requires data card image input (logical unit 5) and print output (logical unit 6). The program consists of a main program and 22 subroutines, (FSDTA,

TABLE 5

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	- X AXIS (METERS) - -82.30	-81.40	-80.50	-79.60	-78.60	-77.70	-76.80	-75.90	-75.00
			- DEPOSITION -						
153.20	.206238+006	.202115+006	.203213+006	.205261+006	.206019+006	.207985+006	.213043+006	.218663+006	.218987+006

Y AXIS (METERS)	- X AXIS (METERS) - -74.10	-73.20	-72.20	-71.30	-70.40	-69.50	-68.60	-67.70	-66.80
			- DEPOSITION -						
153.20	.212073+006	.203174+006	.198979+006	.200708+006	.203121+006	.204133+006	.206073+006	.211251+006	.217335+006

Y AXIS (METERS)	- X AXIS (METERS) - -65.80	-64.90	-64.00	-63.10	-62.20	-61.30	-60.40	-59.40	-58.50
			- DEPOSITION -						
153.20	.218262+006	.211396+006	.202440+006	.198056+006	.198865+006	.200595+006	.200937+006	.202431+006	.207150+006

Y AXIS (METERS)	- X AXIS (METERS) - -57.60	-56.70	-55.80	-54.90	-53.90	-53.00	-52.10	-51.20	-50.30
			- DEPOSITION -						
153.20	.212278+006	.212052+006	.204519+006	.194920+006	.189837+006	.190550+006	.192015+006	.191822+006	.192370+006

Y AXIS (METERS)	- X AXIS (METERS) - -49.40	-48.50	-47.50	-46.60	-45.70	-44.80	-43.90	-43.00	-42.10
			- DEPOSITION -						
153.20	.195935+006	.200136+006	.198588+006	.189073+006	.176977+006	.168953+006	.165190+006	.161549+006	.155426+006

FIGURE 3-4. Dispersion Model Calculations Listing

TABLE 5 (CONT.)

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	- X AXIS (METERS) - DEPOSITION -					
	-41.10	-40.20	-39.30	-38.40	-37.50	-36.60
153.20	.148175+006	.143339+006	.137056+006	.123364+006	.100274+006	.733324+005

FIGURE 3-4. (Continued)

CBGS1, CBGS2, CBGS3, EVPMD, EVPML, REGRS, AVGRD, IOPUT, UNRAN, CANPY, TEST, TESS, CBGS4, CBGS5, FOFX, ERFXS, VRTCL, LNPN1, LNPN2, CBGS6 and TITLR). Although the program is written primarily for use on a UNIVAC 1108 computer, the program is easily adaptable to other computers. The program can be segmented by using the subroutines beginning with CBGS and following non-CBGS subroutines as overlay segments. The program would then have 6 segments in addition to the main program segment.

3.2.2 Control Language and Data Deck Setup

Control Language Requirements. The following illustrates the required executive control statement runstream for a typical run on a UNIVAC 1108 operating system.

1. @RUN,priority jobid,account,userid,time,pages

2. @SYM PRINT$,,device — Optional, used to direct output to a print device

3. @ASG,A prog-file.

4. @ASG,A data-file. — Optional, used only when the FSCBG program input data has been placed in a file or data element within a file.

5. @ASG,CP print-file.
   @BRKPT PRINT$/print-file — Optional, used to direct print output to a specific device when running in demand mode

6. @XQT prog-file.FSCBG

7. `card-input-data` — input FSCBG data on card or typed from a terminal

   or

   `@ADD data`

   or

   `@ADD data-file.data-name` — FSCBG input data have been placed in a file or element within a file

8. `@BRKPT PRINT$`
   `@FREE print-file.`
   `@SYM print-file,,device` — Optional, used with 5 above to direct the print output to a specific print device

9. `@FIN`

where

priority = job run priority

jobid = six-character user supplied job identification

account = account number

userid = up to 12 character user supplied project or user number

time = execution time required in minutes

pages = output pages required

device = printer symbiont name, onsite or remote, to which you desire the print file to go

prog-file = the name of the program file. This illustration assumes the user has assembled and collected the FSCBG program into this file and called the absolute program FSCBG

data-file = the name of an optional data file into which the user has placed the input card image data for FSCBG

print-file = optional, user supplied, file name to be used for the FSCBG print output file.

card-input-data = FSCBG program input card image data defined in Section 3.1.2 and shown in Figure 3-5.

Data Deck Setup. The card image input data required by the FSCBG program depends on the program options desired by the user. The card image input deck may be partitioned into five major groups of card data. Figure 3-5 illustrates the input deck setup. Note that some of the card groups shown may be omitted from the input deck, depending on the program options chosen. The five major input groups are:

1. Required Input data. These data consist of 1 or more data card images that are always included in the input deck. Figure 3-5 shows the 5th and 6th card image of this group are input only if a specific parameter on the preceeding card is zero.

2. Wake Model Input Data. Only one of these two data card images is included in the input deck, depending on ISW(1).

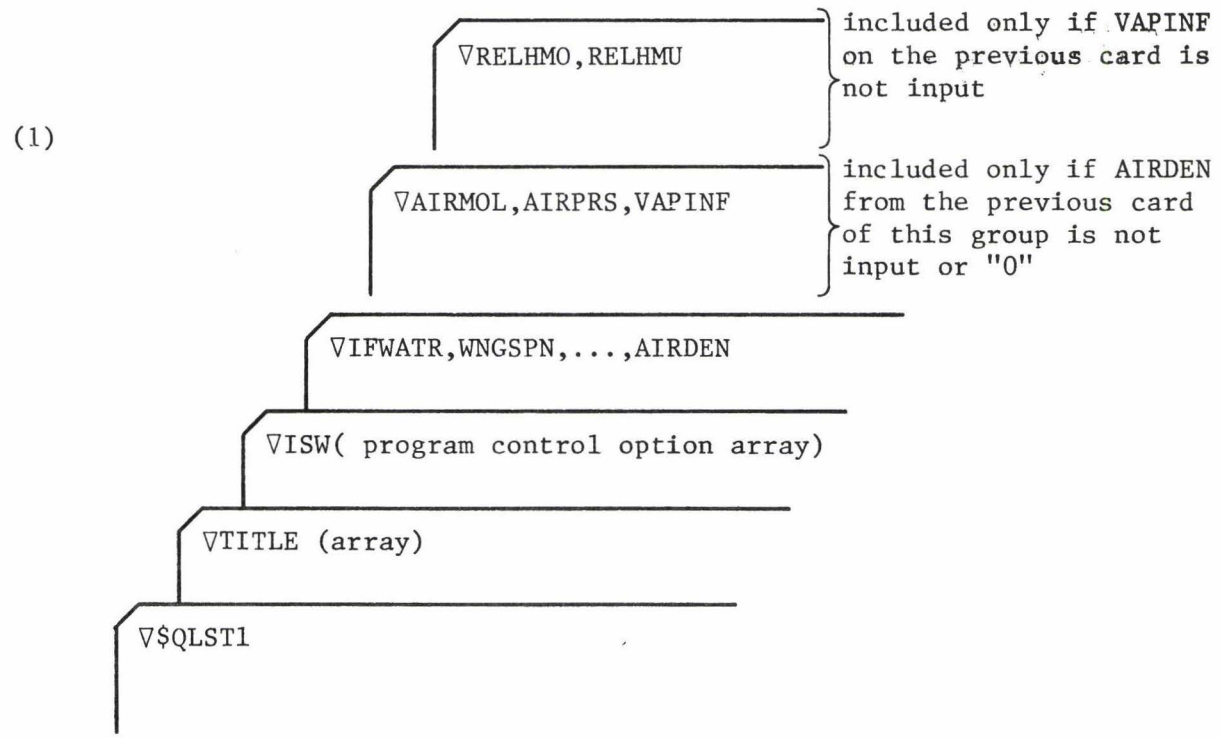
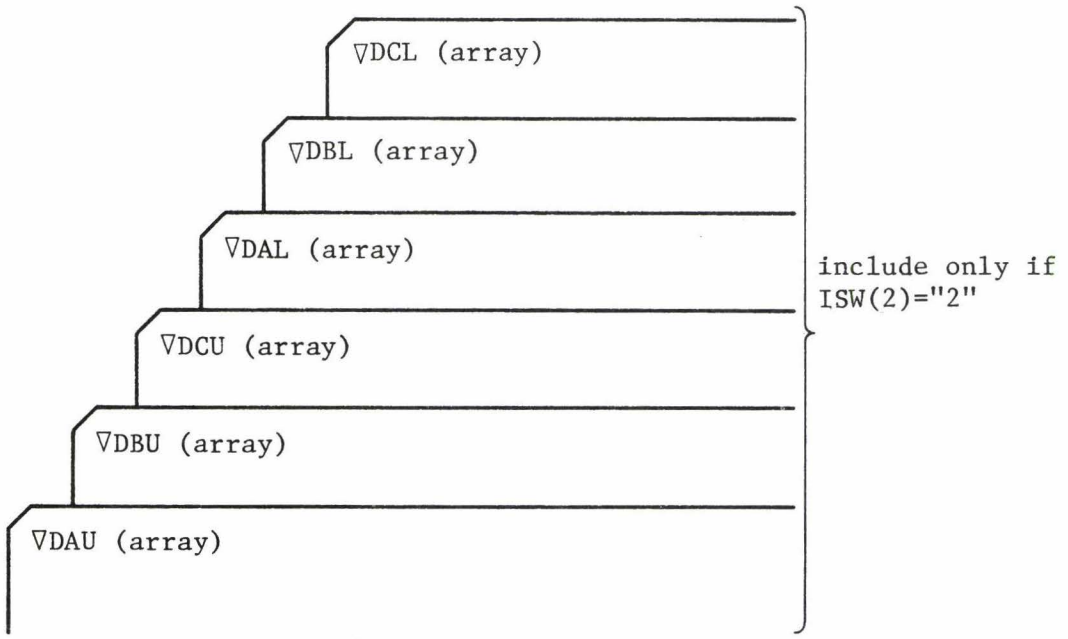
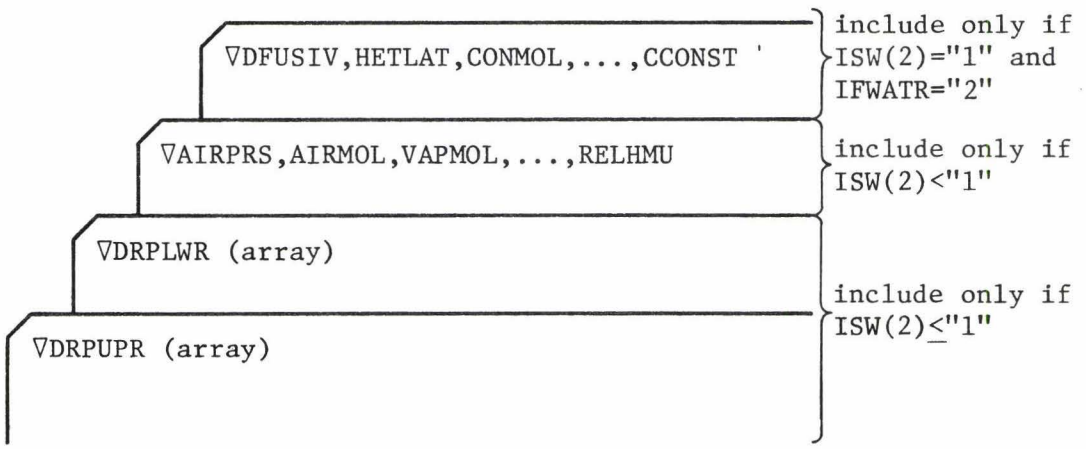

(1)
∇RELHMO,RELHMU
included only if VAPINF on the previous card is not input
∇AIRMOL,AIRPRS,VAPINF
included only if AIRDEN from the previous card of this group is not input or "0"
∇IFWATR,WNGSPN,...,AIRDEN
∇ISW(program control option array)
∇TITLE (array)
∇$QLST1
(Required Input Data)

FIGURE 3-5. Input data deck setup for the FSCBG program. (the ∇ smybol means blank or no punch).



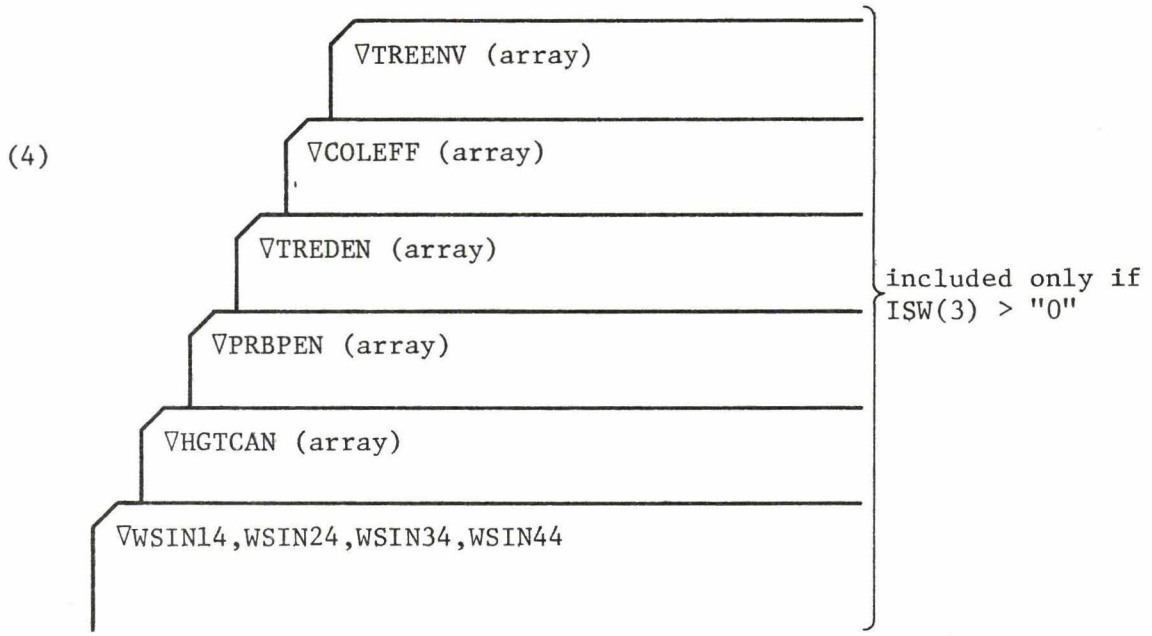
(3)



(Evaporation Model Input Data)

FIGURE 3-5. (Continued)

(the ∇ symbol means blank or no punch)



(Canopy Penetration Model Input Data)

FIGURE 3-5. (Continued)

(the ∇ symbol means blank or no punch)

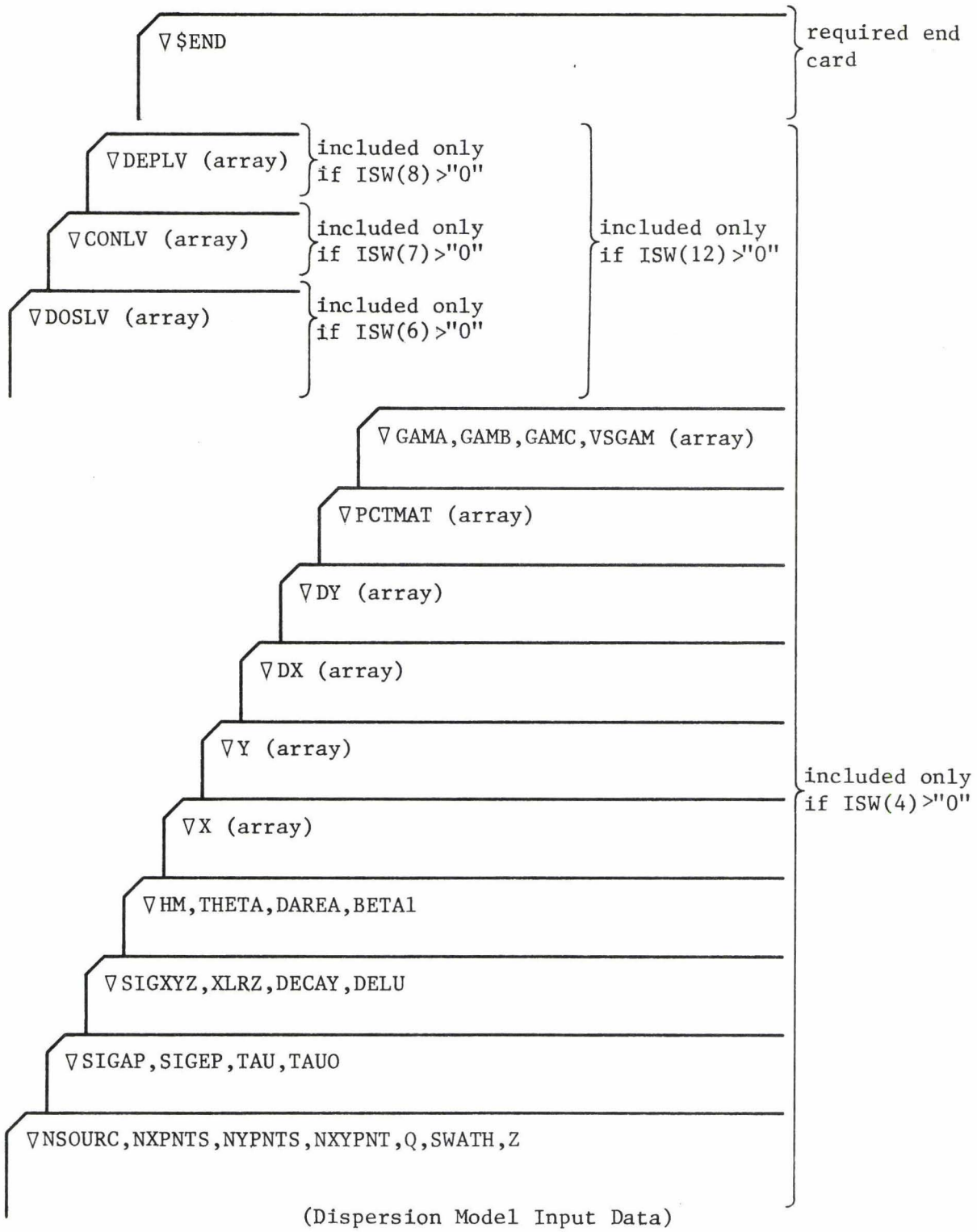


FIGURE 3-5. (Continued)

(the ∇ symbol means blank or no punch)

3. Evaporation Model Input Data. The data cards required in this section of the deck depend on the parameters ISW(2) and IFWATR. Two or more of these data cards will always be included in the input deck.

4. Canopy Penetration Model Input Data. These data cards are included in the input deck only if option ISW(3) is greater than zero.

5. Dispersion Model Input Data. These data cards are included in the input deck only if option ISW(4) is greater than zero. Also, the last three cards of this group depend on ISW(12), ISW(6), ISW(7) and ISW(8).

6. The last data card of the input deck must end with $END.

3.2.3 Input Data Deck Format

The format of the FSCBG program input data is the FORTRAN NAMELIST format and is described in detail in Section 3.2.4 below. The NAMELIST name is QLST1 and the first card of the input deck must have $QLST1 punched in columns 2 through 7 with columns 1 and 8 both blank. The FSCBG input parameter names and values follow on the first and subsequent data cards and are terminated by $END preceded by at least one blank. Column one of the input data deck must never be punched. Figure 3-5 shows the form of the input deck. These data may be entered directly into the runstream following the @XQT card or may be added (@ADD) from a previously created file or symbolic element within a previously created file. Table 3-1 gives the name of each input parameter, limits, default values and a summary description of each parameter. Also, Figure 3-6 gives a set of example input data coding forms for the FSCBG program.

TABLE 3-1

FSCBG PROGRAM INPUT DATA PARAMETERS

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Optional Program Control Data				
TITLE	N/A	80 Characters	Blanks	Run Titling Information
ISW(1)	0,1	1	0	Wake-settling velocity option- 0=use parameter WAKVEL for the wake settling velocity 1=calculate the wake settling velocity from ARCRWT,WNGSPN, ARCRSP and AIRDEN
ISW(2)	0,1,2	1	0	Evaporation model option- 0=spray drops are not evaporated, but used as input in all model calculations 1=spray drops are evaporated. Evaporated size is used in model calculations 2=user inputs the coefficients of the equations that describe drop size as a function of time
ISW(3)	0,1,2	1	0	Canopy penetration model option- 0=no canopy 1=execute canopy penetration model 2=execute and print calulations from canopy penetration model

* if the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(4)	0,1	1	0	Dispersion models option- 0=no dispersion model 1=execute one or more of the dispersion models, depending on ISW(6),ISW(7) and ISW(8)
ISW(5)	0,1	1	0	Print evaporation model calculations option 0=do not print calculations 1=print calculations
ISW(6)	0,1	1	0	Dosage model option- 0=do not calculate dosage 1=calculate dosage
ISW(7)	0,1	1	0	Concentration model option- 0=do not calculate concentration 1=calculate concentration
ISW(8)	0,1	1	0	Deposition model option 0=do not calculate deposition 1=calculate deposition

* If the parameter is omitted from the input deck, the parameter assumes its reactive default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(9)	0,1,2,3, 4 or 5	1	0	Dosage, concentration and deposition mass output units option- 0=drops 1=micrograms 2=milligrams 3=grams 4=ounces 5=pounds
ISW(10)	0,1	1	0	Dosage time output units option- 0=seconds 1=minutes
ISW(11)	0,1,2,3,4	1	0	Dosage, concentration and deposition volume or area length units output option dos: 0=m^3, 1=ft^3, 2=m^3, 3=ft^3, 4=m^3 con: m^3, ft^3, m^3, ft^3, m^3 dep: m^2, ft^2, acre, acre, hectare area of coverage: m^2, ft^2, acre, acre, hectare
ISW(12)	0,1	1	0	Area-coverage option- 0=do not calculate area coverage 1=calculate area-coverage for dosage, concentration and/or deposition, depending on ISW(6),ISW(7) and/or ISW(8)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(13)				
ISW(14)				
ISW(15)				
ISW(16)				

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
ISW(17)				
ISW(18)				
ISW(19)				
ISW(20)				

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Required Input Parameters				
IFWATR	1,2	1	1	Spray liquid base 1=water spray 2=non-water spray
WNGSPN	>0	1	N/A	Aircraft wing span or helicopter rotor diameter (m)
WSOCAN	>0	1	N/A	Wind speed above the canopy
HGTCFT	>0	1	N/A	Height of aircraft above ground (m)
DENLIQ	>0	1	1.0	Density of drop liquid (g cm^{-3})
AIRTPO	N/A	1	N/A	Air temperature above the canopy (^oC)
AIRTPU	N/A	1	AIRTPO	Air temperature below the canopy (^oC)
AIRDEN	>0	1	**	Air density (g cm^{-3})
Parameters that are Required if ISW(1)=0				
WAKVEL	$\geq$0	1	N/A	Wake-settling velocity (m s^{-1})

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

** If this parameter is omitted from the input deck, the parameters AIRMOL, AIRPRS and VAPINF are required. Further, if VAPINF is omitted, the parameters RELHMO and RELHMU are required

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
	Parameters that are Required if ISW(1)=1			
ARCRWT	>0	1	N/A	Aircraft weight (kg)
ARCRSP	>0	1	N/A	Aircraft ground-speed ($m\ s^{-1}$)
Parameters that are Required if ISW(2) $\leq$ 1				
DRPUPR	>0	20	N/A	Upper limit to the drop diameter for each drop size category. Input in descending order of size (micrometers)
DRPLWR	>0	20	DRPUPR***	Lower limit to the drop diameter (micrometers) for each drop size category. Input in descending order of drop size.
Parameters that are Required if ISW(2)=1				
AIRPRS	>0	1	1013.25***	Air pressure (mb)
AIRMOL	>0	1	28.9644***	Molecular weight of air ($g\ mole^{-1}$)
VAPMOL	>0	1	18.015***	Molecular weight of evaporating vapor ($g\ mole^{-1}$)
RELHMO	>0	1	N/A	Relative humidity above the canopy (%)
RELHMU	$\geq$0	1	RELHMO***	Relative humidity below the canopy (%)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter equals 0 or is omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Parameters that are Required if ISW(2)=1 and IFWATR=2				
DFUSIV	>0	1	****	Diffusivity of the evaporating vapor into air at the drop temperature ($cm^2\ s^{-1}$)
HETLAT	>0	1	****	Latent heat of vaporization (cal $mole^{-1}$)
CONMOL	>0	1	****	Molal concentration of the air-liquid mixture (moles cm^{-3})
THERMC	>0	1	****	Thermal conductivity of the vapor into air at the drop temperature (cal s^{-1} cm^{-1} ^oK)
VAPINF	$\geq$0	1	****	Vapor pressure of the evaporating vapor at infinity (mb)
BCONST, CCONST	>0, >0	1,1	21.07,*** 5249.9	Vapor pressure equation constants

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

**** The default value for these parmeters is calculated assuming similar to water.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
Parameters that are Required if ISW(2)=2				
DAU,DBU, DCU	N/A	20,20 20	N/A	Coefficients of the equation of drop size as a function of time for each drop size category above the canopy $D=DAU+DBU\cdot t+DCU\cdot t^2$ Input each array in descending order of drop size
DAL,DBL, DCL	N/A	20,20 20	DAU,DBU, DCU	Coefficients of the equation of drop size as a function of time for each drop-size category below the canopy $D=DAL+DBL\cdot t+DCL\cdot t^2$ Input each array in descending order of drop size
Parameters that are Required if ISW(3)>0				
WSIN44	>0	1	WSOCAN***	Wind speed in top quarter of canopy (m s^{-1})
WSIN34	>0	1	WSIN44***	Wind speed in third quarter of canopy (m s^{-1})
WSIN24	>0	1	WSIN34***	Wind speed in second quarter of canopy (m s^{-1})
WSIN14	>0	1	WSIN24***	Wind speed in bottom quarter of canopy (m s^{-1})

* if the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
HGTCAN	>0	3	N/A	Height of each forest canopy height class (m)
PRBPEN	>0 & ≤1	3	N/A	Probability of drop penetration (fraction) for each canopy height class
TREDEN	>0	3	N/A	Tree density (stems $acre^{-1}$) for each canopy height class
COLEFF	>0 & ≤1 or <0	20 or 3	-13	Collection efficiencies (fraction) for each drop size category or Diameters (cm) of the vegetative elements representative of each canopy height class. Input as negative values
TREENV	>0	100	N/A	Tree envelope (width) (m) at each meter of tree height for each canopy height class from 1 meter above the ground to HGTCAN. Input HGTCAN(1) values, followed by HGTCAN(2) values, followed by HGTCAN(3) values
Parameters that are Required if ISW(4)>0				
NSOURC	>0 & ≤100	1	1***	Number of line sources or aircraft spray lines

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
NXPNTS	****	1	0	Number of X (east-west) coordinates in receptor grid system
NYPNTS	****	1	0	Number Y (north-south) coordinates in receptor grid system
NXYPNT	****	1	0	Number of discrete (arbitrarily placed) receptors
Q	>0	1	1***	Emission of spray material in g m^{-1} if SWATH=0, in gal $acre^{-1}$ if SWATH>0
SWATH	$\geq$0	1	0***	Distance between spray lines (m) if Q is in gallons/acre, otherwise omit or input as 0
Z	$\geq$0	1	0***	Height of dosage, concentration and deposition calculations (m)
SIGAP	>0	1	N/A	Standard deviation of the wind azimuth angle (radians or degrees)
SIGEP	>0	1	N/A	Standard deviation of the wind elevation angle (radians or degrees)
TAU	>0	1	2.5***	Time to spray cloud stabilization (s)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value is used if the parameter is 0 or omitted.

**** 100$\geq$NXPNTS+NYPNTS+2*NXYPNT and 737$\geq$NXPNTS*NYPNTS+NXYPNT.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
TAUO	>0	1	600***	Measurement time for SIGAP(s)
SIGXYZ	>0	1	WNGSPN/4.3***	Standard deviation of the source material along the spray line (m)
DECAY	$\geq$0	1	0***	Coefficient of time dependent exponential decay for the removal of material due to physical or chemical processes
XLRZ	$\geq$0	1	****	Lateral and vertical reference distance (m)
DELU	$\geq$0	1	0	Wind-speed shear above the canopy ($m\ s^{-1}$)
HM	>0	1	N/A	Surface mixing layer height (m)
THETA	$\geq$0 & $\leq$360	1	N/A	Wind direction (degrees clockwise from north)
DAREA	>0	1	10000***	Area assignment for discrete receptor points (m^2)

* If the parameter is omitted from the imput deck, the parameter assumes its respective default value.

*** Default value if the parameter is 0 or omitted.

**** This parameter is normally calculated by the program. However, if XLRZ is input $\geq$ 0, the input value is used.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
BETA1	≥ 0	1	0***	Ratio of Lagrangrian to Eulerian time-scales used in the correction factor on SIGEP and SIGAP for crossing-trajectory effects of heavy drops (fraction). Recommended value is 1.0, if used
X	N/A	NXPNTS +NXYPNT	N/A	X axis of receptor grid system followed by discrete receptor X coordinates. X axis should be in ascending order of value (m)
Y	N/A	NYPNTS +NXYPNT	N/A	Y axis of receptor grid system followed by discrete receptor coordinates. Y axis should be in ascending order of value (m)
DX	N/A	2*NSOURC	N/A	Start and end X coordinate of each source (m)
DY	N/A	2*NSOURC	N/A	Start and end Y coordinate of each source (m)
PCTMAT	≥ 0 & ≤ 1	20	N/A	Fraction of total spray material in each drop-size category
VSGAM	>0	2	.04, .012	Settling velocities that divide the curve of surface reflection coefficient as a function of settling velocity into three curves ($m\ s^{-1}$)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

*** Default value if the parameter is 0 or omitted.

TABLE 3-1 (Continued)

Parameter Name	Limits for Input Value	Maximum Number of Values	Default * Values	Description
GAMA,GAMB, GAMC	N/A	3 each	GAMA=.75, .83465302, .91639996 GAMB=-2.5, -6.9031391, -22.357124 GAMC=0.0, 57.409256, 821.42651	Coefficients of equations using the surface reflection coefficient as a function of drop settling velocity VS>VSGAM(1) uses GAMA(1), GAMB(1) & GAMC(1) VSGAM(1)>VS>VSGAM(2) uses GAMA(2), GAMB(2) & GAMC(2) VSGAM(2)>VS uses GAMA(3), GAMB(3) & GAMC(3)
Parameters that are Required if ISW(12)>0				
DOSLV	N/A	10	N/A	Dosage levels in units same as output dosage for dosage area-coverage (required only if ISW(6)>0)
CONLV	N/A	10	N/A	Concentration levels in units same as output concentration for concentration area-coverage (required only if ISW(7)>0)
DEPLV	N/A	10	N/A	Deposition levels in units same as output deposition for deposition area-coverage (required only if ISW(8)>0)

* If the parameter is omitted from the input deck, the parameter assumes its respective default value.

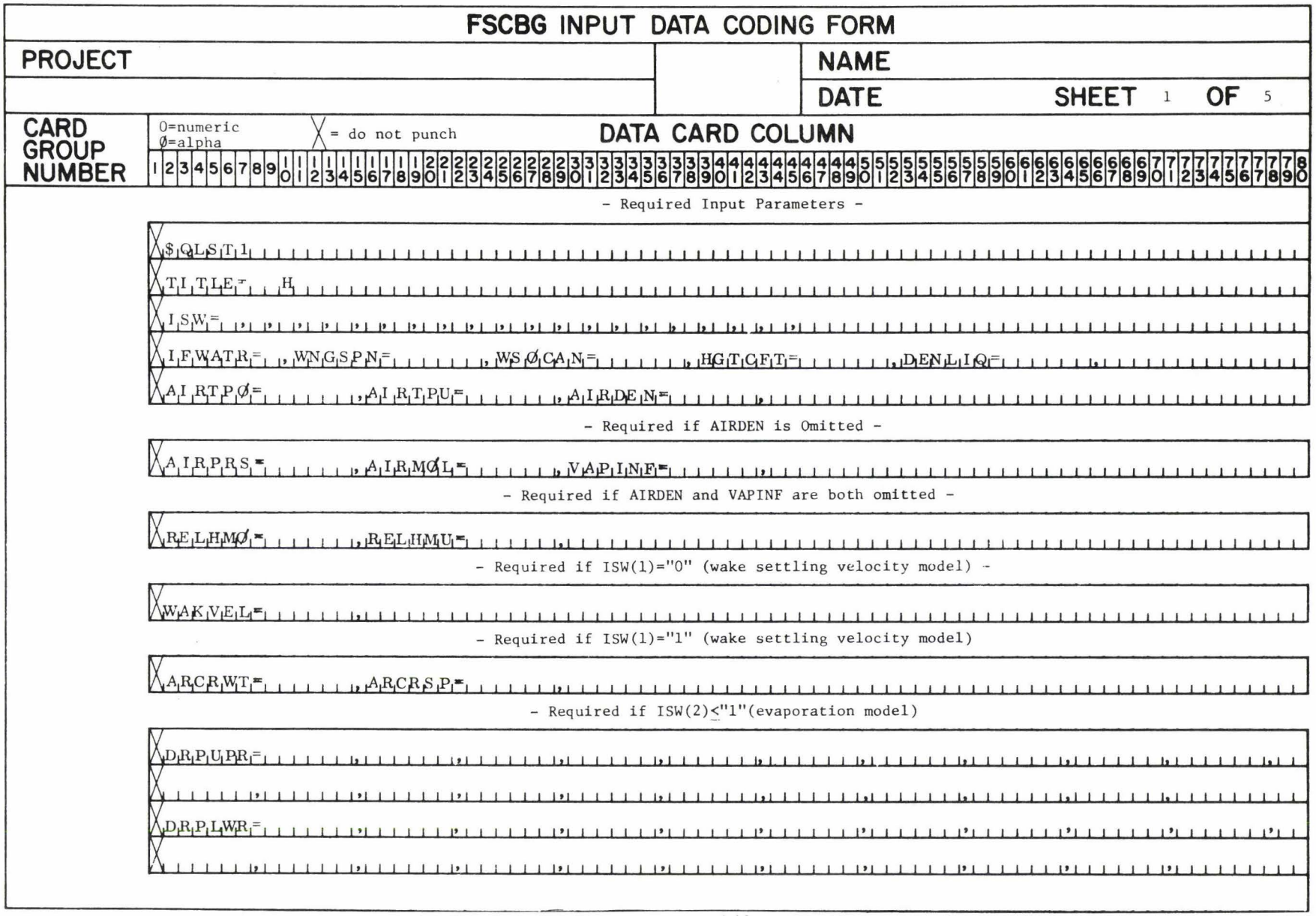


FIGURE 3-6. Example FSCBG Input Data Coding Forms.

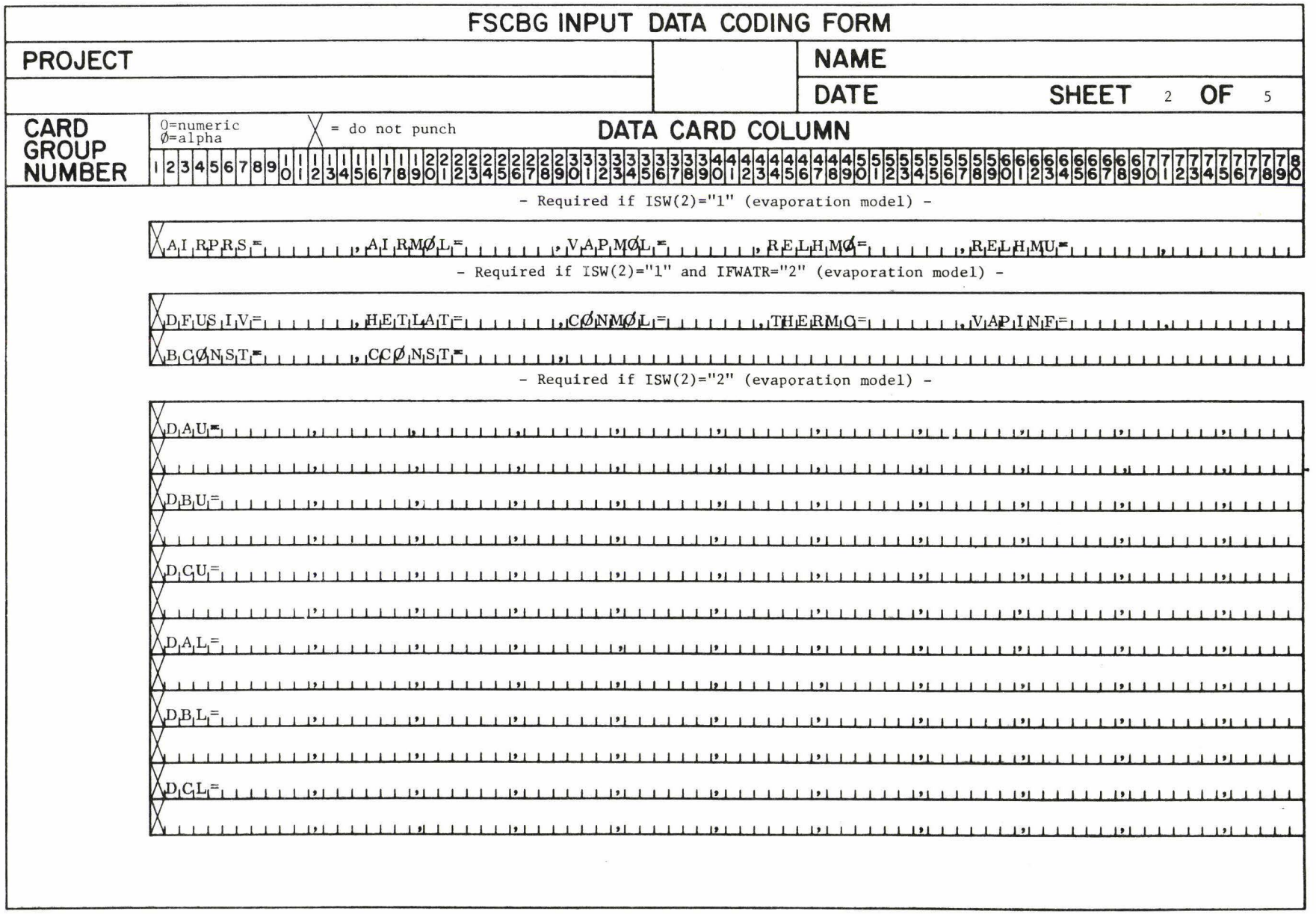


FIGURE 3-6. (Continued)

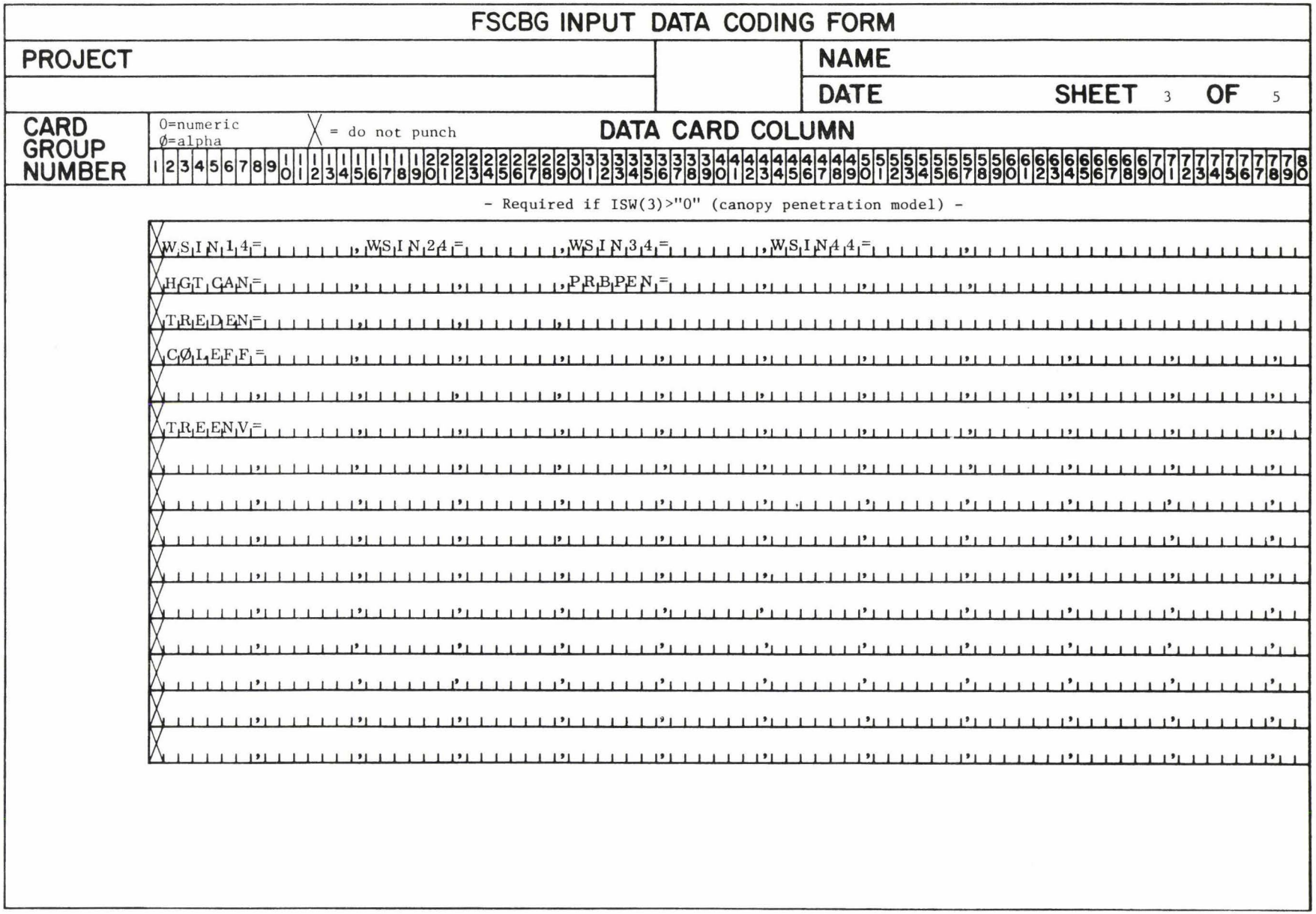

FSCBG INPUT DATA CODING FORM
PROJECT
NAME
DATE
SHEET 3 OF 5
CARD GROUP NUMBER
0=numeric
Ø=alpha
X = do not punch
DATA CARD COLUMN
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
- Required if ISW(3)>"0" (canopy penetration model) -
WSIN14=
WSIN24=
WSIN34=
WSIN44=
HGTCAN=
PRBPEN=
TREDEN=
CØLEFF=
TREENV=

FIGURE 3-6. (Continued)

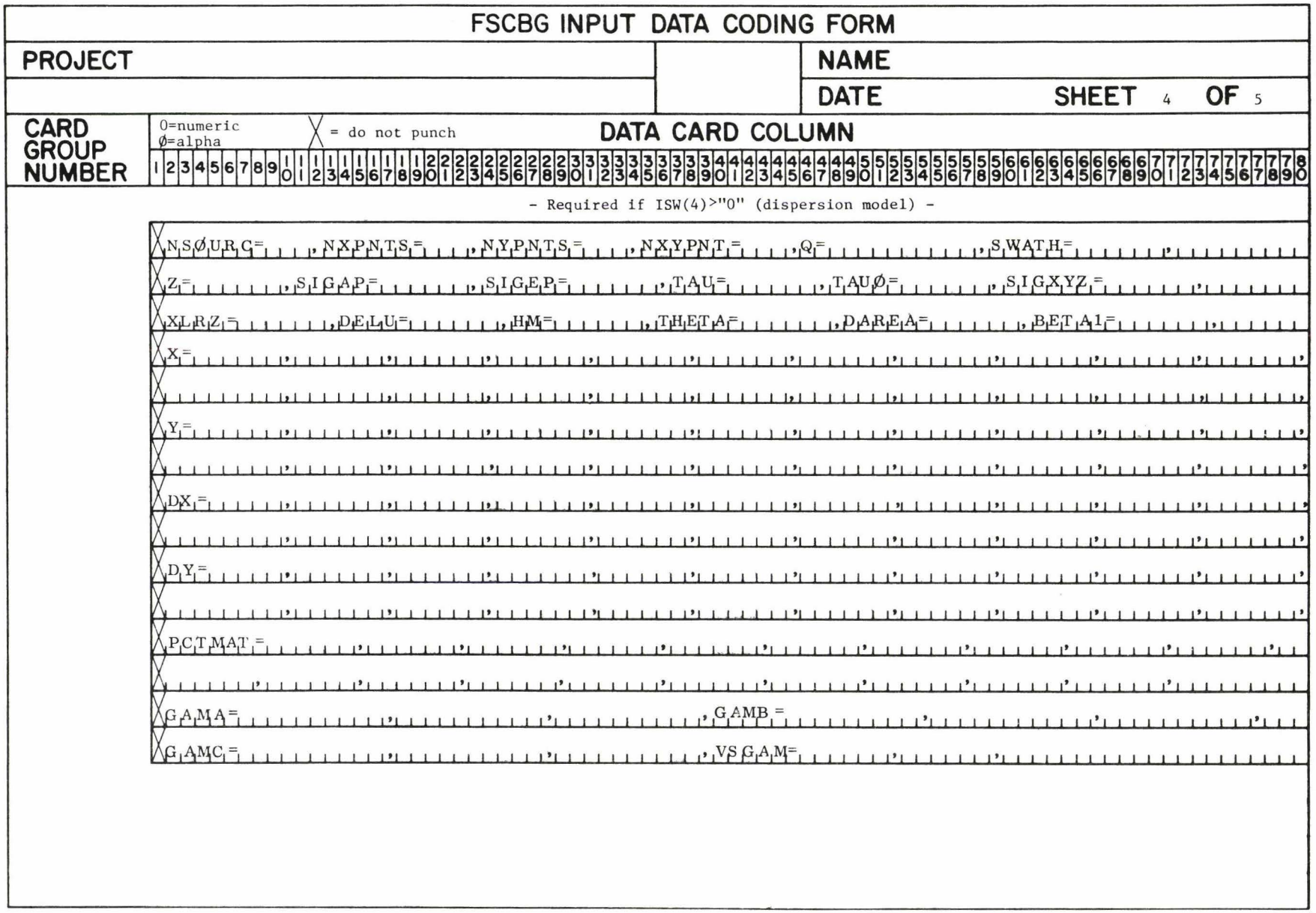


FIGURE 3-6. (Continued)

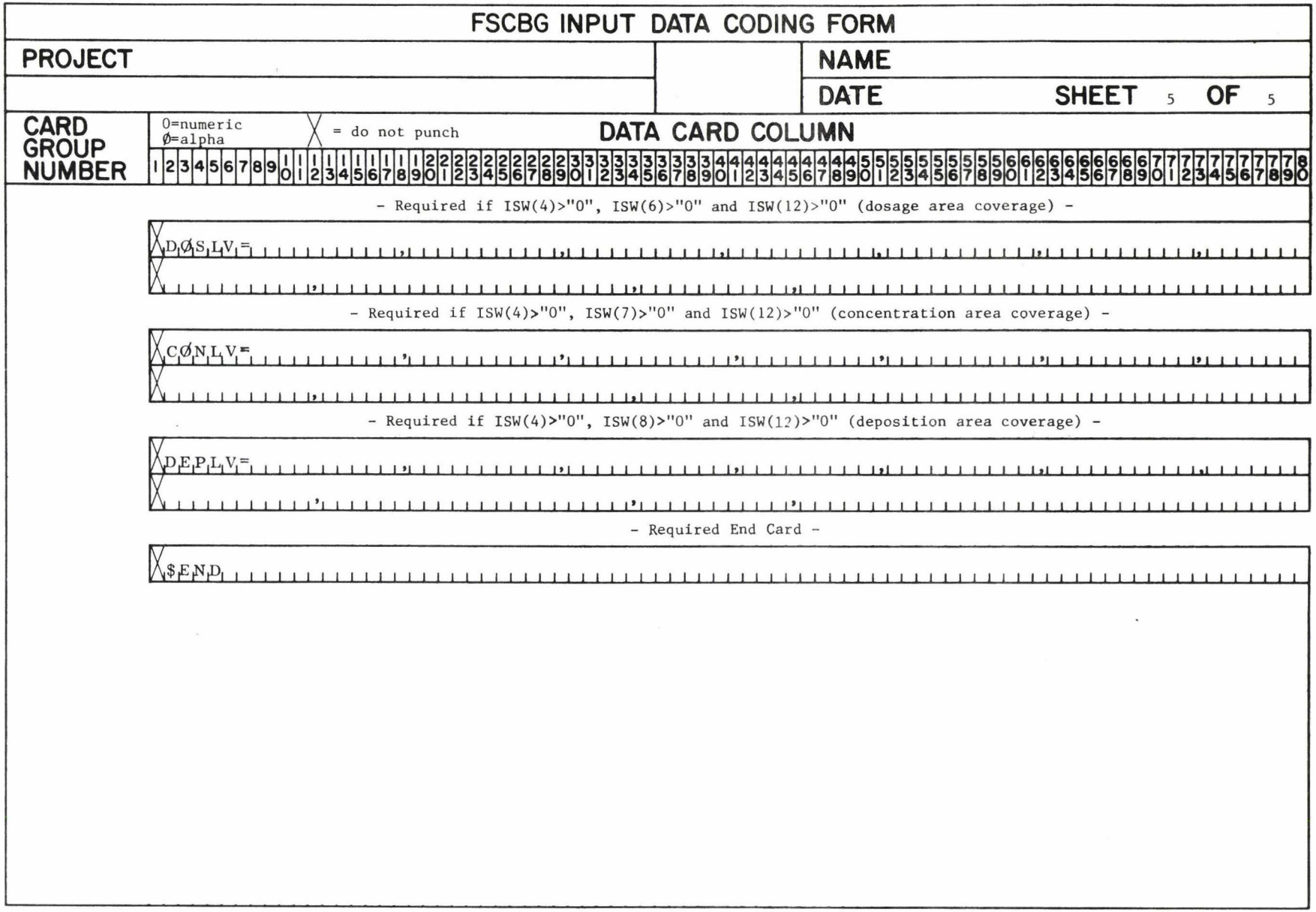


FIGURE 3-6. (Continued)

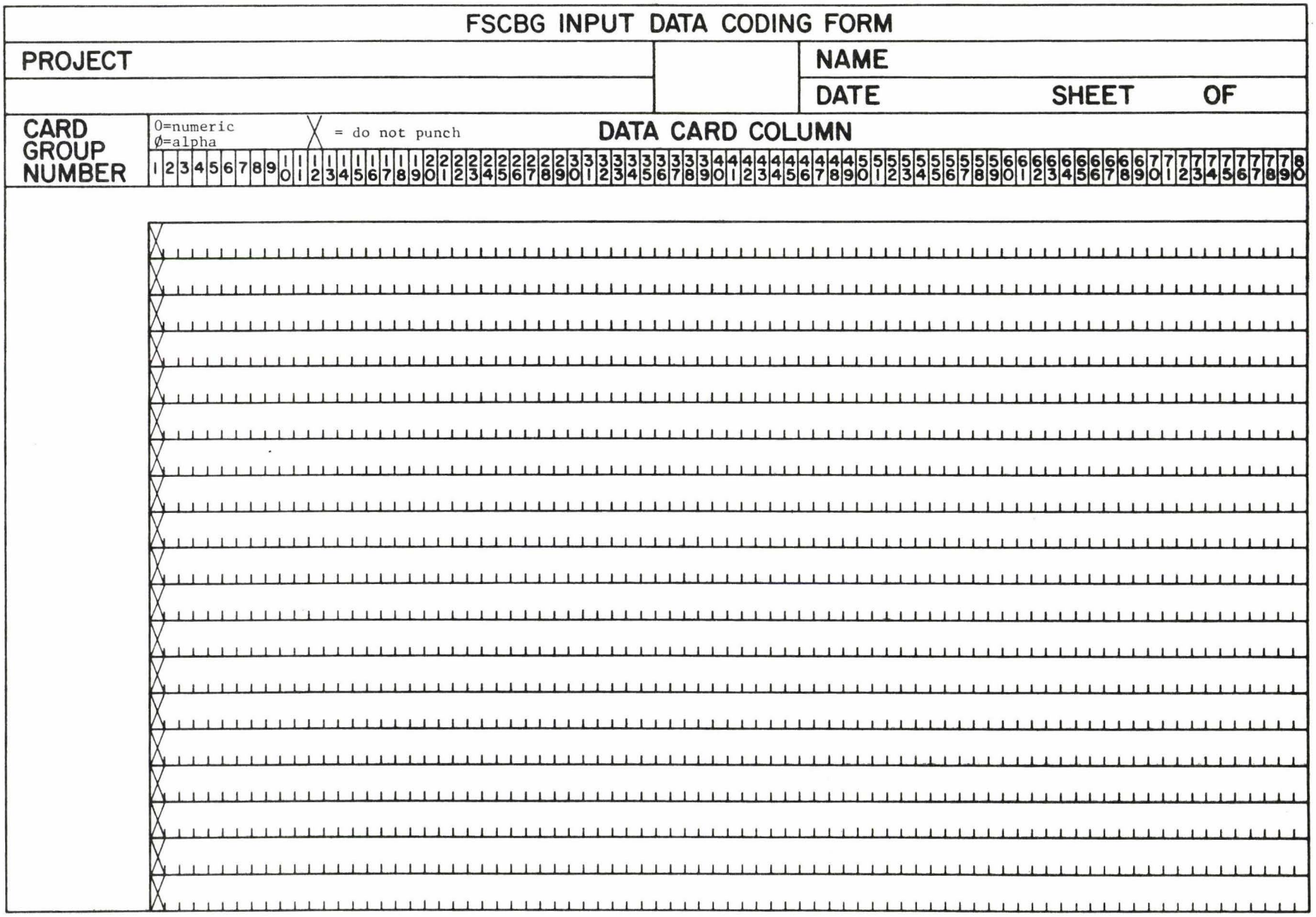


FIGURE 3-6. (Continued)

3.2.4 NAMELIST Input Format

The FSCBG computer program uses the FORTRAN NAMELIST DATA input format for input of control data. The namelist input data must be in a specific form in order to be read using a NAMELIST list. The first character (column 1) in each input card must be blank. The first card in the namelist deck contains the namelist name QLST1, preceded by the character $ (QLST1). The $ must be punched in column 2 and the name QLST1 must be followed by at least one blank. The last card in the input deck contains $END, preceded by at least one blank, to terminate the control data input. Use the character & rather than $ on IBM computers. The form of the data items within the deck may be:

a. Variable Name = Constant, -- The variable name may be a subscripted array name (ISW(4)) or a single variable name WAKVEL. Subscripts must be constants. The Constant may be an integer (whole number) or may be real (fractional part) and is terminated by a comma. Integer input parameter variables are those that begin with the letter I, J, K, L, M or N and must have a whole number Constant value. Real input parameters are those variables that begin with any other letter and may have a fractional part (45.342). Also, real parameters may have a Constant of the form X.XXEII, where E denotes the power of 10 of the value.

Example:

```
IFWATR=1,WNGSPN=9.144,WSOCAN=4.6,
HGTCFT=30,
```

b. Array Name = Set of Constants, -- The Array Name is not subscripted. The Set of Constants consists of constants of the type real or integer, depending on the Array Name, and all are separated by commas. The number of constants must be less than or equal to the

maximum allowed by the program for the specific Array Name. Successive occurrence of the same constant value can be represented in the form k*Constant.

Example:

```
ISW=0,1,2,1,1,2*0,1,1,
DRPUPR=414.0,365,341,320,304,282,265,249,
```

c. Array Name = nnH ... Hollerith String ..., -- The Array Name is not subscripted (or is a simple Variable Name). The Hollerith String consists of labeling information or format information of any characters desired. There are exactly nn characters of information (including blanks) following the H and preceding a terminating comma. The only FSCBG input parameter that may use this form is TITLE.

Example:

```
TITLE=37HRUN TITLE FOR FSCBG PROGRAM EXECUTION,
```

Input parameters and array elements that are not included (punched) in the input deck assume their respective default values.

3.2.5 Program Run Time and Page Output Estimates

This section gives approximations to the computer run time and page output for the FSCBG program. Because of the variability of problem runs and input parameters, the equations in this section are meant only to give an approximation of the upper limit of the time and page usage function.

a. Run Time. The run time required for a problem run is given by

$$\text{Time (Seconds)} = N_d \Big[(f_1 \cdot H_o + f_2) + (f_3 \cdot H_u + f_4) + \big(N_c \cdot (f_5 \cdot H_u/N_t + f_6)\big) + \big((N_x \cdot N_y + N_{xy}) \quad (3\text{-}14)$$

$$N_s \cdot (f_7 \cdot H_o + f_8) \cdot f_9 \big) \Big]$$

where

N_d = the number of drop size categories

H_o = the humidity above the canopy (RELHMO)

H_u = the humidity below the canopy (RELHMU)

N_c = the number of tree height classes (multi-storied) canopy

N_t = the number of trees (stems) per acre (TREDEN)

N_x = the number of receptors in the grid system x axis (NXPNTS)

N_y = the number of receptors in the grid system y axis (NYPNTS)

N_{xy} = the number of discrete receptors (NXYPNT)

N_s = the number of sources (NSOURC)

$$f_1 \cong \begin{cases} 2.3\text{x}10^{-3} & ; \text{ if ISW(2)="1"} \\ 0 & ; \text{ if ISW(2)}\neq\text{"1"} \end{cases}$$

$$f_2 \cong \begin{cases} 1.6 & ; \text{ if ISW(2)="1"} \\ 0.4 & ; \text{ if ISW(2)}\neq\text{"1"} \end{cases}$$

$$f_3 \cong \begin{cases} 1.9\text{x}10^{-4} & ; \text{ if ISW(2)="1" \& ISW(3)>"0"} \\ 0 & ; \text{ if ISW(2)}\neq\text{"1" or ISW(3)="0"} \end{cases}$$

$$f_4 \cong \begin{cases} 0.5 & ; \text{ if ISW(2)="1" \& ISW(3)>"0"} \\ 0 & ; \text{ if ISW(3)="0"} \\ .90 & ; \text{ if ISW(2)}\neq\text{"1" \& ISW(3)> "0"} \end{cases}$$

$$f_5 \cong \begin{cases} 2.7 & ; \text{ if ISW(3)>"0"} \\ 0 & ; \text{ if ISW(3)="0"} \end{cases}$$

$$f_6 \cong \begin{cases} 9.0 & ; \text{ if ISW(3)>"0"} \\ 0 & ; \text{ if ISW(3)="0"} \end{cases}$$

$$f_7 \cong 2.0\text{x}10^{-4}$$

$$f_8 \cong 5.0\text{x}10^{-3}$$

$$f_9 \cong \begin{cases} 1 & ; \text{ if ISW(6) \& ISW(7)="0"} \\ 5 & ; \text{ if ISW(6) or ISW(7)>"0"} \end{cases}$$

The user should add any other time expected from other processing within the job to the estimate calculated via Equation 3-14. Also, if the values of f_i above are not appropriate for your computer, recalculate and replace the f_i values.

b. Page Output. The number of pages of print output from the FSCBG program depends on the problem being run and is given by

$$\text{Pages} \cong A + B + C + D \qquad (3\text{-}15)$$

where

$$A = \begin{cases} 1 & ; \text{ if ISW(5)="0"} \\ 2 + 4 \cdot N_d & ; \text{ if ISW(5)>"0"} \end{cases}$$

$$B = \begin{cases} 1 & ; \text{ if ISW(5)="0" or ISW(3)="0"} \\ 2 + 3 \cdot N_d & ; \text{ if ISW(5)>"0" \& ISW(3)>"0"} \\ 2 & ; \text{ if ISW(5)="0" \& ISW(3)>"0"} \end{cases}$$

$$C^* = \begin{cases} 0 & ; \text{ if ISW(4)="0"} \\ 1 + \left[\dfrac{5 + \left[\dfrac{N_x}{9} \right] \cdot \left(9 + N_y \right)}{57} \right] \cdot \left(\text{ISW(6)+ISW(7)+ISW(8)} \right) & ; \text{ if ISW(4)>"0"} \end{cases}$$

$$D = \begin{cases} 0 & ; \text{ If ISW(12)="0"} \\ \text{ISW(6)+ISW(7)+ISW(8)} & ; \text{ if ISW(12)>"0"} \end{cases}$$

The user should add any other pages expected from the remainder of the job to the estimate calculated via Equation 3-15.

---

* The [] symbols mean to round up to the next integer if there is any fractional part.

SECTION 4
FSCBG EXAMPLE PROBLEM

4.1 FSCBG EXAMPLE PROBLEM DESCRIPTION

As we have indicated, the FSCBG model computer program can be used to calculate the deposition of drops within and below forest canopies for comparison with measurements. In this example problem, we use the dispersion and deposition models to calculate drop deposition along a line of deposition card samplers placed at ground level beneath a southern slash pine seed orchard canopy. A schematic diagram of the orchard and position of the card sampling line is shown in Figure 4-1. The rows of trees are separated by 30 feet and the spacing between stems along each row is 15 feet. The spray aircraft, a Stearman biplane, flies north and south between rows of trees beginning between rows 11 and 12 and ending between rows 6 and 7. The aircraft is assumed to fly at an altitude of 60 feet above ground and to spray a water-based pesticide at a rate of 57.33 grams per meter. The rectangular coordinate system used in defining the problem has its origin at the first tree in row 1 shown at the lower right-hand corner of Figure 4-1.

Meteorological Input Parameters

For the example problem, which is based in part on an actual experiment conducted by the Forest Service, we have assumed that meteorological measurements were made above the canopy using a bidirectional wind sensor and a temperature sensor mounted on a 18-meter tower. An analysis of the recorded wind azimuth and elevation data over a 10-minute measurement period (τ_o=600 seconds) beginning at the time the aircraft started to release the spray material yielded estimates of the standard deviations of the wind azimuth angle (σ_A) and wind elevation angle (σ_E) shown in Table 4-1. The mean wind direction (θ) and wind speed ($\bar{u}$) shown in

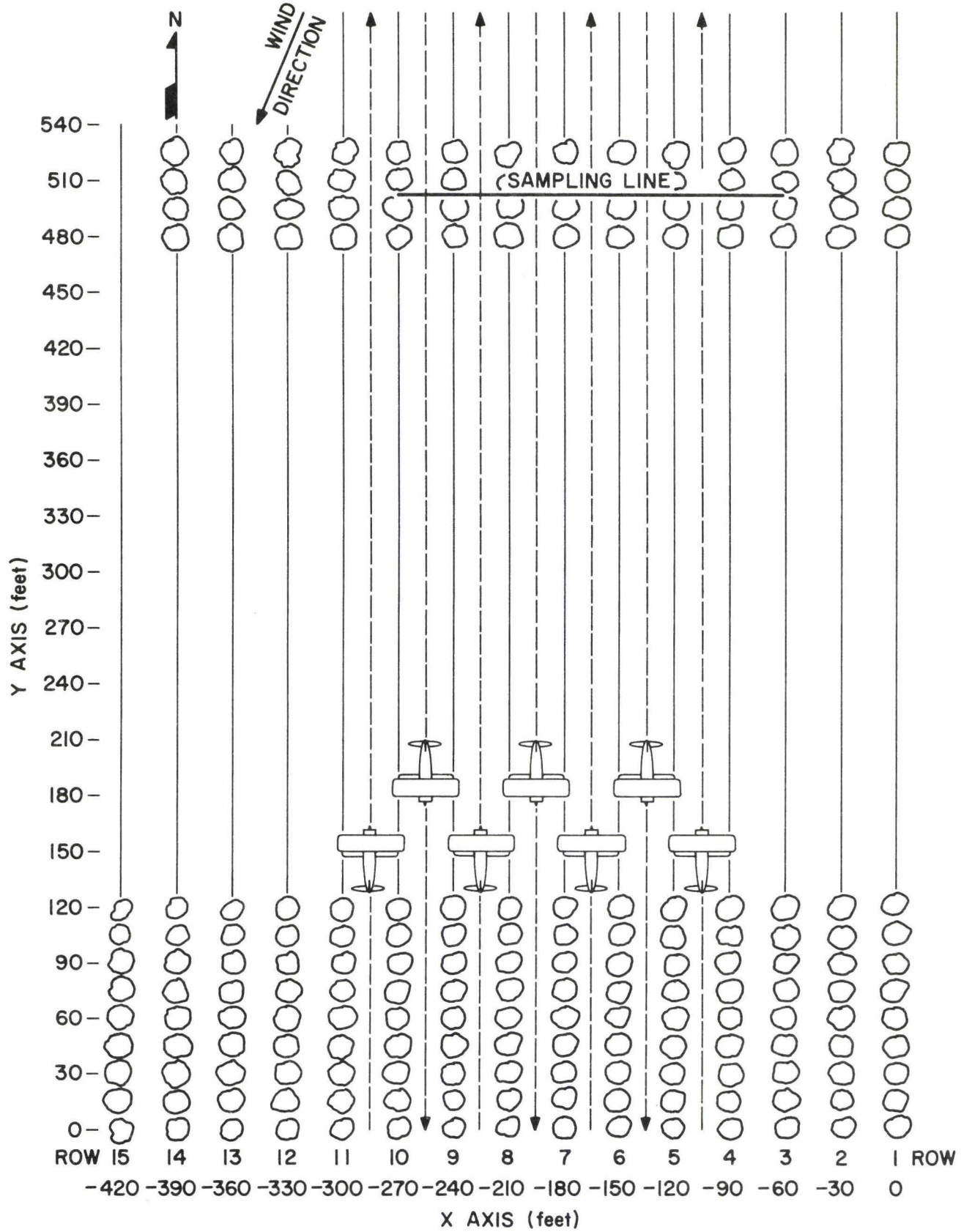


FIGURE 4-1. Example spray problem design.

TABLE 4-1

METEOROLOGICAL INPUT PARAMETERS

Parameter	Program Symbol	Value
$\sigma_A\{\tau_o=600s\}$ (deg)	SIGAP	14.1
σ_E (deg)	SIGEP	11.7
H_m (m)	HM	1000
$\bar{u}$ (m s^{-1})	WSØCAN	1.02
θ (deg)	THETA	23
$\Delta\bar{u}$ (m s^{-1})	DELU	0
P_A (mb)	AIRPRS	1013.25
RH (%)	RELHMØ	98.9
T_A (^oC)	AIRTPØ	14.4
$\bar{u}_{c;1}$ (m s^{-1})	WSIN14	0.95
$\bar{u}_{c;2}$ (m s^{-1})	WSIN24	0.84
$u_{c;3}$ (m s^{-1})	WSIN34	0.82
$u_{c;4}$ (m s^{-1})	WSIN44	0.90

Table 4-1 were also estimated for the 10-minute period from the wind sensor. The wind speed shear ($\Delta\bar{u}$) above the canopy was set equal to zero because wind speed was measured only at a single height and furthermore the shear was not expected to have a significant influence on the calculations. The temperature above the canopy (T_A) was 14.4 degrees Celsius. The relative humidity (RH) was measured near ground level. The measured values of air temperature and relative humidity shown in Table 4-1 were assumed in the example problem to represent the temperature and relative humidity both above and within the canopy. The wind speeds within the canopy ($\bar{u}_{c,k}$) shown in the table are based on a normalized height profile for winds in an isolated conifer stand presented by Fritschen, et al. (1970).

Source Input Parameters

Source input parameters used in the model calculations are shown in Table 4-2. The source dimension σ_o was determined form observations that the spray cloud quickly attained a dimension equal to about 1.5 wingspans behind the aircraft. The value of σ_o was determined by dividing this dimension by 4.3 (σ_o=1.5b/4.3) under the assumptions that the distribution of material within the spray cloud was Gaussian and that the visible edge of the cloud represented the point at which the concentration was one-tenth the concentration at the cloud centroid. The aircraft air speed was approximately 90 miles per hour (40.2 m s^{-1}) along the flight lines shown in Figure 4-1. The flight lines were longer than shown in the schematic diagram, each line actually extending from 384.3 meters south (y=-384.3 m) to 370 meters north (y=370.3) of the first tree in Row 1.

Table 4-3 shows the spray drop-size distribution used in the example calculations. This distribution is based on drop-size measurements made during trials in which the Stearman aircraft disseminated material over a sampling line in an open area.

TABLE 4-2

SOURCE INPUT PARAMETERS

Parameter	Program Symbol	Value
Q ($g\ m^{-1}$)	Q	57.33
H (m)	HGTCFT	18.1
σ_o (m)	SIGXYZ	4.0
W_a (kg)	ARCWGT	1406
b (m)	WNGSPN	11.48
V_a ($m\ s^{-1}$)	ARCRSP	40.2

TABLE 4-3

SPRAY DISTRIBUTION PARAMETERS

Drop Upper Limit (m) DRPUPR	Drop Lower Limit (m) DRPLWR	Fraction of Material In Drop-Size Category PCTMAT
1420	1020	0.01
1020	840	0.02
840	742	0.03
742	667	0.04
667	577	0.10
577	514	0.10
514	456	0.10
456	351	0.20
351	302	0.10
302	253	0.10
253	200	0.10
200	169	0.04
169	135	0.03
135	100	0.02
100	51.6	0.009
51.6	20.0	0.001

Forest Description Parameters

Forest description parameters for the example problem are shown in Table 4-4. Since the spacing between trees is 15 feet along the rows and there is 30 feet between rows, the tree density is

$$D_t = \frac{1 \text{ stem}}{(30\text{x}15)\ \text{ft}^2} \times \frac{43560\ \text{ft}^2}{\text{acre}} = \frac{96.8 \text{ stems}}{\text{acre}}$$

The average measured height of the trees (H_c) in the vicinity of the sampling line was 12 meters. The tree widths W_i for heights from 1 to 12 meters were obtained by averaging measurements made of four typical trees near the sampling line. In the calculations, the program was set to calculate impaction efficiencies (E_j) from Equation (2-77) using a default value of s equal to 13 centimeters.

4.2 FSCBG EXAMPLE PROBLEM INPUT DATA

The input data used for this example problem are shown in Figure 4-2 coded on example coding forms identical to those shown in Section 3. Parameters and arrays on the coding forms that are crossed out indicate parameters that are not required (WAKVEL), were previously specified (RELHMO on sheet 2), are being defaulted (AIRTPU) or are trailing comma's that have no associated coded value. The first data card image begins with $QLST1 (the name of the NAMELIST) and the deck ends with $END. The second input card shows the 47 character title. Following the title the program option switch ISW is coded. The option switch values shown in Figure 4-2 specify that the program is to calculate the wake-settling velocity, that spray drops are to be evaporated, a canopy is used and print output from the canopy model is desired, dispersion modeling is to be done, evaporation model results are to be printed,

TABLE 4-4

FOREST DESCRIPTION PARAMETERS

Parameter	Program Symbol	Value
D_t (stems acre^{-1})	TREDEN	98.6
H_c (m)	HGTCAN	12
PRPEN	PRPEN	0.38
W_i i=1	TREENV	0.21
2		0.19
3		0.19
4		3.8
5		6.6
6		6.2
7		5.8
8		6.4
9		5.0
10		4.0
11		3.3
12		1.6

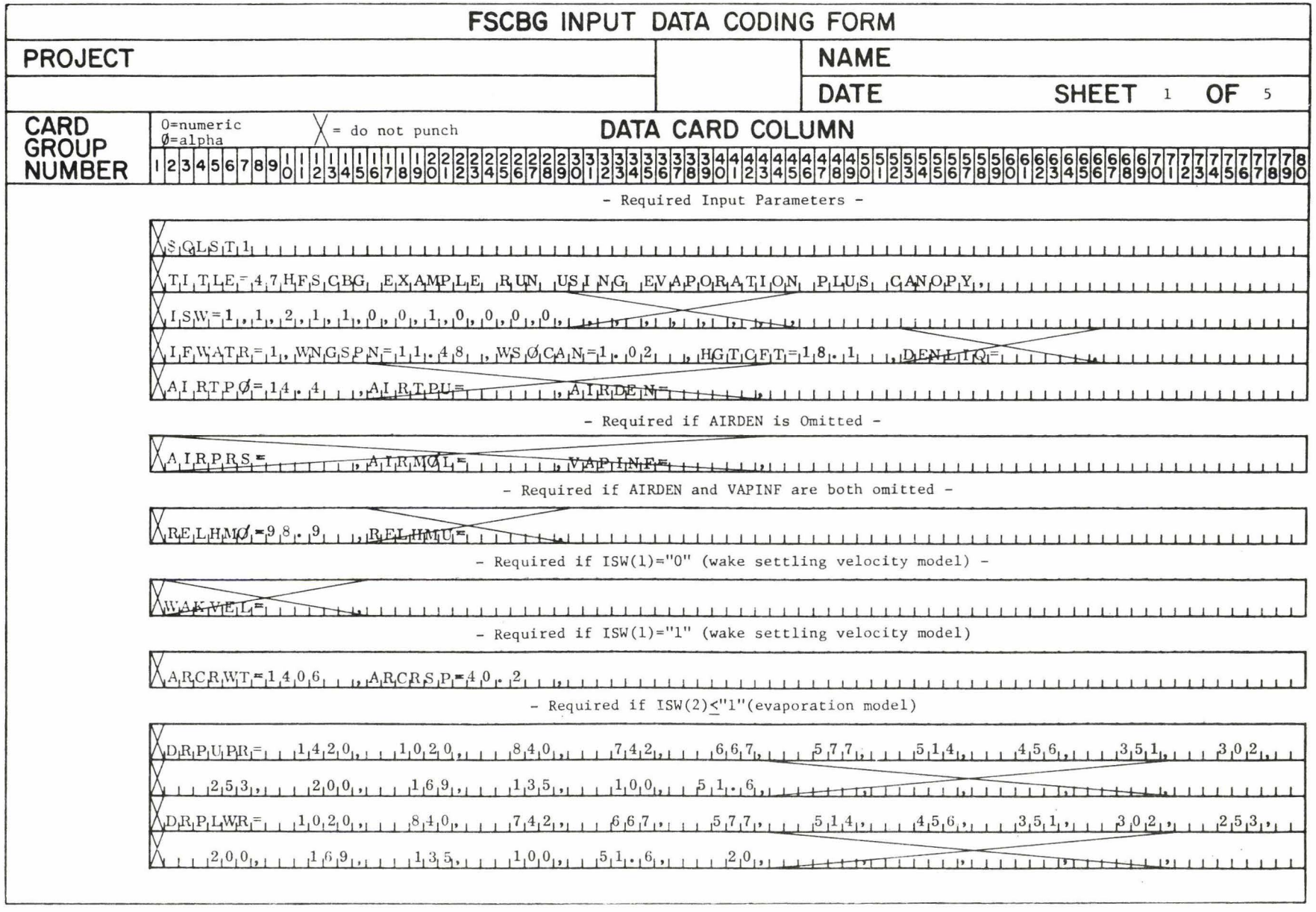

FSCBG INPUT DATA CODING FORM
PROJECT
NAME
DATE
SHEET 1 OF 5
CARD GROUP NUMBER
0=numeric
Ø=alpha
X = do not punch
DATA CARD COLUMN
- Required Input Parameters -
SCLST1
TITLE=47HFSCBG EXAMPLE RUN USING EVAPORATION PLUS CANOPY,
ISW=1,1,2,1,1,0,0,1,0,0,0,0,
IFWATR=1, WNGSPN=11.48, WSØCAN=1.02, HGTCFT=18.1, DENLIQ=
AIRTPØ=14.4, AIRTPU=, AIRDEN=
- Required if AIRDEN is Omitted -
AIRPRS=, AIRMØL=, VAPINF=
- Required if AIRDEN and VAPINF are both omitted -
RELHMØ=98.9, RELHMU=
- Required if ISW(1)="0" (wake settling velocity model) -
WAKVEL=
- Required if ISW(1)="1" (wake settling velocity model)
ARCRWT=1406, ARCRSP=40.2,
- Required if ISW(2)≤"1"(evaporation model)
DRPUPR=1420, 1020, 840, 742, 667, 577, 514, 456, 351, 302,
253, 200, 169, 135, 100, 51.6,
DRPLWR=1020, 840, 742, 667, 577, 514, 456, 351, 302, 253,
200, 169, 135, 100, 51.6, 20,

FIGURE 4-2. FSCBG Example Problem Input Data

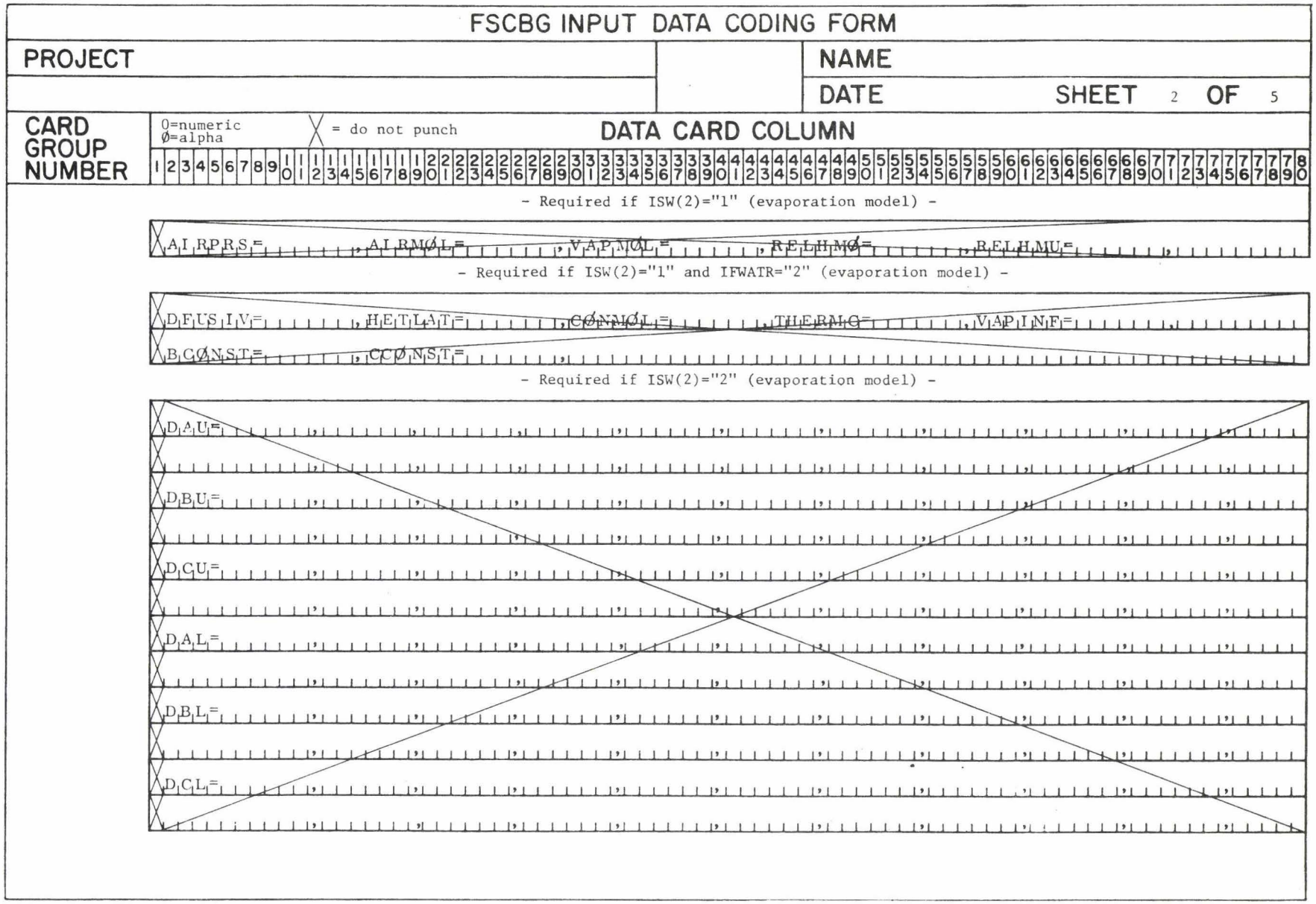


FIGURE 4-2. (Continued)

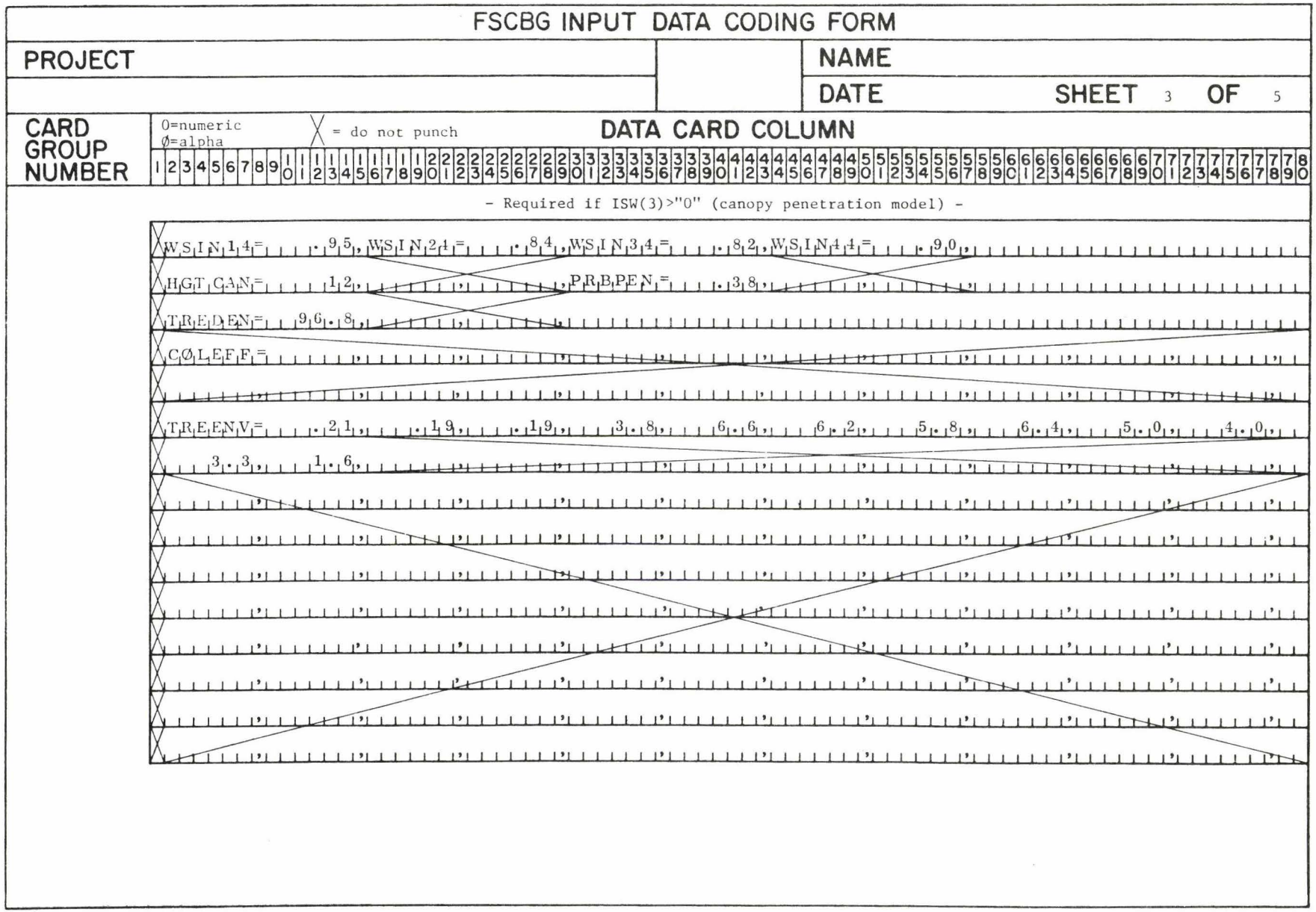


FIGURE 4-2. (Continued)

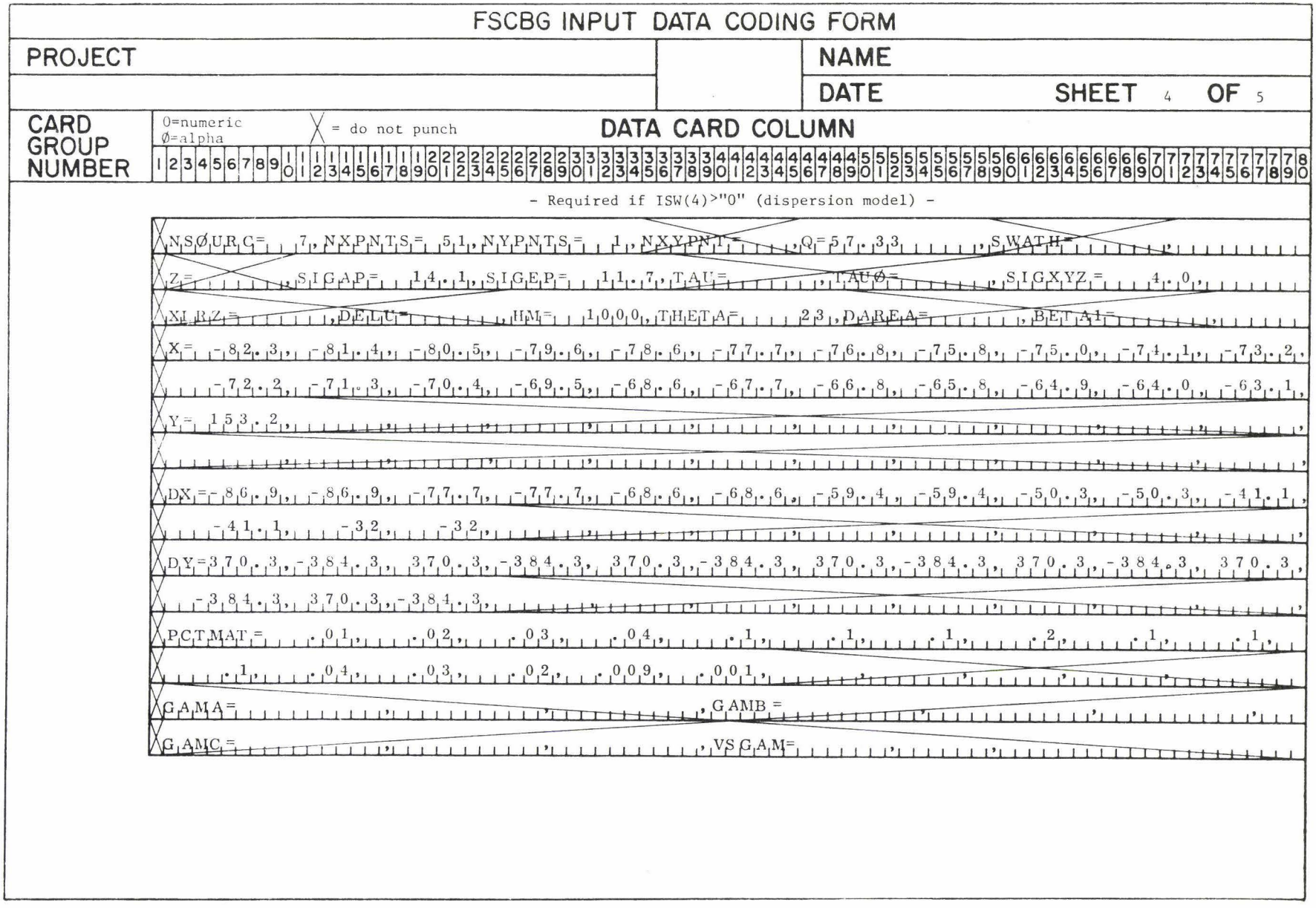

FSCBG INPUT DATA CODING FORM
PROJECT
NAME
DATE
SHEET 4 OF 5
CARD GROUP NUMBER
0=numeric
Ø=alpha
X = do not punch
DATA CARD COLUMN
- Required if ISW(4)>"0" (dispersion model) -
NSØURC= 7, NXPNTS= 51, NYPNTS= 1, NXYPNT= , Q= 57.33 , SWATH= ,
Z= , SIGAP= 14.1, SIGEP= 11.7, TAU= , TAUØ= , SIGXYZ= 4.0,
XLRZ= , DELU= , HM= 1000, THETA= 23, DAREA= , BETA1= ,
X= -82.3, -81.4, -80.5, -79.6, -78.6, -77.7, -76.8, -75.8, -75.0, -74.1, -73.2,
-72.2, -71.3, -70.4, -69.5, -68.6, -67.7, -66.8, -65.8, -64.9, -64.0, -63.1,
Y= 153.2,
DX= -86.9, -86.9, -77.7, -77.7, -68.6, -68.6, -59.4, -59.4, -50.3, -50.3, -41.1,
-41.1, -32, -32,
DY= 370.3, -384.3, 370.3, -384.3, 370.3, -384.3, 370.3, -384.3, 370.3, -384.3, 370.3,
-384.3, 370.3, -384.3,
PCTMAT= .01, .02, .03, .04, .1, .1, .1, .2, .1, .1,
.1, .04, .03, .02, .009, .001,
GAMA= , GAMB= ,
GAMC= , VSGAM= ,

FIGURE 4-2. (Continued)

FSCBG INPUT DATA CODING FORM
PROJECT
NAME
DATE
SHEET 5 OF 5
CARD GROUP NUMBER
0=numeric
Ø=alpha
X = do not punch
DATA CARD COLUMN
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
- Required if ISW(4)>"0", ISW(6)>"0" and ISW(12)>"0" (dosage area coverage) -
DØSLV=
- Required if ISW(4)>"0", ISW(7)>"0" and ISW(12)>"0" (concentration area coverage) -
CØNLV=
- Required if ISW(4)>"0", ISW(8)>"0" and ISW(12)>"0" (deposition area coverage) -
DEPLV=
- Required End Card -
$END

FIGURE 4-2. (Continued)

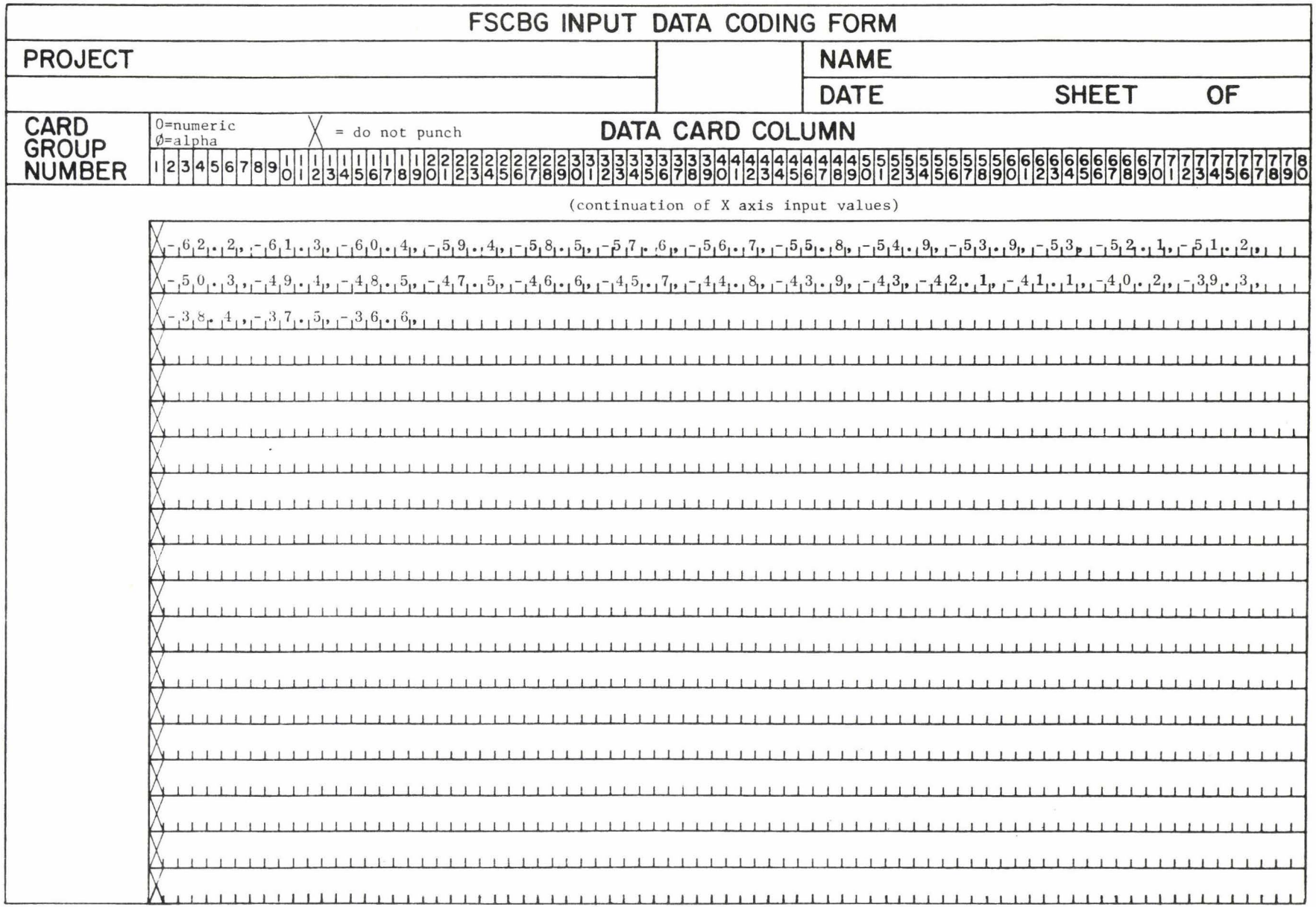


FIGURE 4-2. (Continued)

dosage is not calculated, concentration is not calculated, deposition is to be calculated, output mass units are drops, dosage time units do not apply, length output units are meters and, finally, area coverage is not calculated. Following the program options are the remainder of the "required" input parameters. A "required" parameter means that a value for the parameter must be either input or defaulted and does not mean that punching a value for the parameter is required. For example, the parameters DENLIQ, AIRTPU and AIRDEN have been omitted (crossed out) because a default value will be used for these parameters. Input parameters for the evaporation model and canopy penetration model are given on sheets (upper right corner) 1 through 3 of Figure 4-2. Those for the dispersion models are given on pages 4 through 5 and on the extra sheet following sheet 5. This extra sheet is provided for those arrays that exceed the space provided on sheets 1 through 5. For example, there is not enough room to code all of the values for the x axis of the receptor grid system on sheet 4, so the remainder of the x axis values have been coded on the extra sheet shown after sheet 5. Any values coded on this extra sheet that are continuations of values previously shown must be merged back into the input deck in their proper position prior to execution of the program.

4.3 FSCBG EXAMPLE PROBLEM OUTPUT

The FSCBG example problem output is shown in Figure 4-3. Only selected pages of the program output have been included in Figure 4-3 due to the size of the output listing (114 total pages). The first page of Figure 4-3 gives the FSCBG required input data, wake-settling velocity model input data and the evaporation model input data. Note that some parameters have ***** symbols for a value. This means the value was not specified on input and is to be defaulted or calculated by the FSCBG program. The second and third pages of Figure 4-3 show the input data

TABLE 1
- PROGRAM INPUT DATA -
(NOTE - ******* MEANS NOT APPLICABLE)

```
     *** INPUTS USED BY ALL MODELS ***
PROGRAM OPTIONS, (ISW) = 1 1 2 1 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0
IS LIQUID WATER OR NON-WATER, 2=NON-WATER, 1=WATER, (IFWATR) = 1
AIRCRAFT WING SPAN (WNGSPN (METERS)) =  11.48
WIND SPEED ABOVE CANOPY (WSOCAN (M/S)) = 1.020
HEIGHT OF AIRCRAFT (HGTCFT (METERS)) =  18.10
DENSITY OF SPRAY LIQUID (DENLIQ (G/CM**3)) =   1.0000
AIR TEMPERATURE ABOVE THE CANOPY (AIRTPO (DEG C)) = 14.400
AIR TEMPERATURE BELOW THE CANOPY (AIRTPU (DEG C)) = 14.400
AIR DENSITY (AIRDEN (G/CM**3)) =*********
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
BAROMETRIC PRESSURE (AIRPRS (MB)) =1013.25
VAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) =*******
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
     *** INPUTS USED BY THE WAKE SETTLING VELOCITY MODEL ***
AIRCRAFT WEIGHT (ARCRWT (KG)) = 1406.000
AIRCRAFT GROUND SPEED (ARCRSP (M/S)) =  40.200
     *** INPUTS USED BY THE EVAPORATION MODEL ***
UPPER LIMITS OF DROP DIAMETERS (DRPUPR (MICRO-M)) =
1420.000,1020.000, 840.000, 742.000, 667.000, 577.000, 514.000,
 456.000, 351.000, 302.000, 253.000, 200.000, 169.000, 135.000,
 100.000,  51.600,
LOWER LIMITS OF DROP DIAMETERS (DRPLWR (MICRO-M)) =
1020.000, 840.000, 742.000, 667.000, 577.000, 514.000, 456.000,
 351.000, 302.000, 253.000, 200.000, 169.000, 135.000, 100.000,
  51.600,  20.000,
BAROMETR  PRESSURE (AIRPRS (MB)) =1013.25
MOLECULAR WEIGHT OF AIR (AIRMOL) = 28.9644
MOLECULAR WEIGHT OF EVAPORATING VAPOR (VAPMOL) = 18.0150
RELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) = 98.900
RELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) = 98.900
```

FIGURE 4-3. FSCBG Example Problem Output Listing.

TABLE 1 (CONT.)
- PROGRAM INPUT DATA -
(NOTE - ******* MEANS NOT APPLICABLE)

```
     *** INPUTS USED BY THE CANOPY PENETRATION MODEL ***
WIND SPEED IN BOTTOM QUARTER OF CANOPY (WSIN14 (M/S)) =   .950
WIND SPEED IN SECOND QUARTER OF CANOPY (WSIN24 (M/S)) =   .840
WIND SPEED IN THIRD QUARTER OF CANOPY (WSIN34 (M/S)) =   .820
WIND SPEED IN TOP QUARTER OF CANOPY (WSIN44 (M/S)) =   .900
HEIGHT OF CANOPY (HGTCAN (METERS)) = 12.00,    .00,    .00,
PROBABILITY OF PENETRATION (PRBPEN) = .380,  .000,  .000,
TREE DENSITY (TREDEN (TREES/ACRE)) =  96.80,    .00,    .00,
DIAMETER OF VEGETATIVE ELEMENTS (COLEFF (CM)) = 13.00, 13.00, 13.00,
TREE WIDTH FROM BOTTOM TO TOP FOR FOREST CLASS 1 (TREENV (M)) =
   .210,   .190,   .190, 3.800, 6.600, 6.200, 5.800, 6.400, 5.000,
  4.000, 3.300, 1.600,
```


FIGURE 4-3. (Continued)

TABLE 1 (CONT.)
- PROGRAM INPUT DATA -
(NOTE - ******* MEANS NOT APPLICABLE)

```
     *** INPUTS USED BY THE DISPERSION MODELS ***
NUMBER OF LINE SOURCES (NSOURC) =   7
NUMBER OF RECEPTORS IN GRID SYSTEM X AXIS (NXPNTS) =  51
NUMBER OF RECEPTORS IN GRID SYSTEM Y AXIS (NYPNTS) =   1
NUMBER OF DISCRETE RECEPTORS (NXYPNT) =   0
EMISSION OF SPRAY MATERIAL (Q (GRAMS/M)) = .573300+002
HEIGHT OF DISPERSION MODELS CALCULATION (Z (M)) =     .00
STANDARD DEV. OF WIND DIRECTION ANGLE (SIGAP (RAD)) = .24609
STANDARD DEV. OF WIND ELEVATION ANGLE (SIGEP (RAD)) = .20420
TIME TO SPRAY CLOUD STABILIZATION (TAU (SEC)) =   2.500
MEASUREMENT TIME FOR SIGAP (TAUD (SEC)) = 600.000
STAND. DEV. OF SPRAY MATERIAL ALONG SPRAY LINE (SIGXYZ (M)))=   4.000
DECAY COEFFICIENT (DECAY (/SEC)) = .000000
LAT., VERT. REFERENCE DISTANCE (XLRZ (M)) =**********
SURFACE MIXING LAYER HEIGHT (HM (M)) = 1000.000
WIND DIRECTION (FROM) (THETA (DEG)) =  23.00
AREA ASSIGNMENT FOR DISCRETE RECEPTORS (DAREA (M**2)) =    10000.00
RATIO OF LAGRANGIAN TO EULERIAN TIME SCALES (BETA1) =   .00
WIND-SPEED SHEAR (DELU (M/S)) =   .0000
X AXIS OF RECEPTOR GRID SYSTEM (X (M)) =    -82.3,    -81.4,
    -80.5,    -79.6,    -78.6,    -77.7,    -76.8,    -75.9,
    -75.0,    -74.1,    -73.2,    -72.2,    -71.3,    -70.4,
    -69.5,    -68.6,    -67.7,    -66.8,    -65.8,    -64.9,
    -64.0,    -63.1,    -62.2,    -61.3,    -60.4,    -59.4,
    -58.5,    -57.6,    -56.7,    -55.8,    -54.9,    -53.9,
    -53.0,    -52.1,    -51.2,    -50.3,    -49.4,    -48.5,
    -47.5,    -46.6,    -45.7,    -44.8,    -43.9,    -43.0,
    -42.1,    -41.1,    -40.2,    -39.3,    -38.4,    -37.5,
    -36.6,
Y AXIS OF RECEPTOR GRID SYSTEM (Y (M)) =    153.2,
START AND END X COORDINATES OF LINE SOURCES (DX (M)) =
    -86.9,    -86.9,    -77.7,    -77.7,    -68.6,    -68.6,
    -59.4,    -59.4,    -50.3,    -50.3,    -41.1,    -41.1,
    -32.0,    -32.0,
START AND END Y COORDINATES OF LINE SOURCES (DY (M)) =
    370.3,   -384.3,    370.3,   -384.3,    370.3,   -384.3,
    370.3,   -384.3,    370.3,   -384.3,    370.3,   -384.3,
    370.3,   -384.3,
FRACTION OF SPRAY MATERIAL FOR EACH DROP CAT. (PCTMAT) = .01000,
  .02000,  .03000,  .04000,  .10000,  .10000,  .10000,  .20000,  .10000,
  .10000,  .10000,  .04000,  .03000,  .02000,  .00900,  .00100,
SETTLING VEL. SPECIFYING WHICH SET OF GAMA, GAMB AND GAMC TO
USE (VSGAM (M S)) =   .0400,   .0120
COEFFICIENTS OF EQUATIONS GIVING SURF. REFLECT. COEFFS. (GAMA,GAMB,GAMC) =
  .750000+000, .834653+000, .916400+000,-.250000+001,-.690314+001,
-.223571+002, .000000    , .574093+002, .821427+003,
```

FIGURE 4-3. (Continued)

TABLE 2
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
AIR DENSITY = .12200585-002 (G/CM**3)
MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .53880651-004 (CAL/(SEC.CM.DEGREE K))
LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
DROP PRESSURE = .16340134+002 (MB)
DROP TEMPERATURE = .14290404+002 (DEGREES C)
WAKE SETTLING VELOCITY = .54999816+000 (M/S)
ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
SCHMIDT NUMBER = .43981910+000

FIGURE 4-3. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
18.100	1420.000	1230.992	1020.000	.0000	.0000	.000	.00	4.9376646	100.000
17.798	1419.999	1230.990	1019.998	.3444-008	.3444-008	.061	.06	4.9376601	100.000
17.497	1419.997	1230.989	1019.997	.6850-008	.3406-008	.122	.12	4.9376557	99.999
17.195	1419.996	1230.988	1019.995	.1029-007	.3436-008	.183	.19	4.9376512	99.999
16.893	1419.994	1230.986	1019.994	.1370-007	.3413-008	.244	.25	4.9376467	99.999
16.592	1419.993	1230.985	1019.992	.1714-007	.3436-008	.305	.31	4.9376423	99.998
16.290	1419.992	1230.983	1019.991	.2053-007	.3391-008	.367	.37	4.9376379	99.998
15.988	1419.990	1230.982	1019.989	.2396-007	.3436-008	.428	.44	4.9376335	99.998
15.687	1419.989	1230.980	1019.988	.2741-007	.3444-008	.489	.50	4.9376289	99.997
15.385	1419.987	1230.979	1019.986	.3081-007	.3406-008	.550	.56	4.9376246	99.997
15.083	1419.986	1230.977	1019.985	.3425-007	.3436-008	.611	.62	4.9376200	99.996
14.782	1419.985	1230.976	1019.983	.3767-007	.3421-008	.672	.69	4.9376156	99.996
14.480	1419.983	1230.975	1019.982	.4108-007	.3406-008	.733	.75	4.9376112	99.996
14.178	1419.982	1230.973	1019.980	.4451-007	.3436-008	.794	.81	4.9376068	99.995
13.877	1419.980	1230.972	1019.979	.4793-007	.3413-008	.855	.87	4.9376023	99.995
13.575	1419.979	1230.970	1019.977	.5135-007	.3421-008	.916	.93	4.9375979	99.995
13.273	1419.978	1230.969	1019.976	.5478-007	.3429-008	.978	1.00	4.9375935	99.994
12.972	1419.976	1230.967	1019.974	.5821-007	.3436-008	1.039	1.06	4.9375890	99.994
12.670	1419.975	1230.966	1019.973	.6163-007	.3421-008	1.100	1.12	4.9375845	99.994
12.368	1419.973	1230.965	1019.971	.6506-007	.3429-008	1.161	1.18	4.9375801	99.993
12.067	1419.972	1230.963	1019.970	.6848-007	.3413-008	1.222	1.25	4.9375756	99.993
11.765	1419.971	1230.962	1019.968	.7192-007	.3444-008	1.283	1.31	4.9375711	99.993
11.463	1419.969	1230.960	1019.967	.7533-007	.3406-008	1.344	1.37	4.9375668	99.992
11.162	1419.968	1230.959	1019.965	.7874-007	.3413-008	1.405	1.43	4.9375623	99.992
10.860	1419.966	1230.957	1019.964	.8215-007	.3413-008	1.466	1.50	4.9375578	99.992
10.558	1419.965	1230.956	1019.962	.8560-007	.3444-008	1.527	1.56	4.9375534	99.991
10.257	1419.964	1230.954	1019.961	.8900-007	.3406-008	1.588	1.62	4.9375490	99.991
9.955	1419.962	1230.953	1019.959	.9244-007	.3436-008	1.650	1.68	4.9375445	99.991
9.653	1419.961	1230.952	1019.957	.9588-007	.3444-008	1.711	1.74	4.9375400	99.990
9.352	1419.959	1230.950	1019.956	.9929-007	.3406-008	1.772	1.81	4.9375356	99.990
9.050	1419.958	1230.949	1019.954	.1027-006	.3413-008	1.833	1.87	4.9375312	99.989
8.748	1419.957	1230.947	1019.953	.1061-006	.3436-008	1.894	1.93	4.9375267	99.989
8.447	1419.955	1230.946	1019.951	.1096-006	.3413-008	1.955	1.99	4.9375222	99.989
8.145	1419.954	1230.944	1019.950	.1130-006	.3436-008	2.016	2.06	4.9375178	99.988
7.843	1419.952	1230.943	1019.948	.1164-006	.3413-008	2.077	2.12	4.9375134	99.988
7.542	1419.951	1230.941	1019.947	.1198-006	.3436-008	2.138	2.18	4.9375089	99.988
7.240	1419.950	1230.940	1019.945	.1233-006	.3413-008	2.199	2.24	4.9375045	99.987
6.938	1419.948	1230.939	1019.944	.1267-006	.3413-008	2.261	2.31	4.9375000	99.987
6.637	1419.947	1230.937	1019.942	.1301-006	.3421-008	2.322	2.37	4.9374956	99.987
6.335	1419.945	1230.936	1019.941	.1335-006	.3452-008	2.383	2.43	4.9374911	99.986
6.033	1419.944	1230.934	1019.939	.1369-006	.3391-008	2.444	2.49	4.9374867	99.986
5.732	1419.943	1230.933	1019.938	.1404-006	.3436-008	2.505	2.56	4.9374823	99.986
5.430	1419.941	1230.931	1019.936	.1438-006	.3413-008	2.566	2.62	4.9374778	99.985

FIGURE 4-3. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
5.128	1419.940	1230.930	1019.935	.1472-006	.3436-008	2.627	2.68	4.9374734	99.985
4.827	1419.939	1230.929	1019.933	.1506-006	.3413-008	2.688	2.74	4.9374689	99.985
4.525	1419.937	1230.927	1019.932	.1541-006	.3436-008	2.749	2.80	4.9374645	99.984
4.223	1419.936	1230.926	1019.930	.1575-006	.3413-008	2.810	2.87	4.9374600	99.984
3.922	1419.934	1230.924	1019.929	.1609-006	.3436-008	2.872	2.93	4.9374556	99.984
3.620	1419.933	1230.923	1019.927	.1643-006	.3406-008	2.933	2.99	4.9374511	99.983
3.318	1419.932	1230.921	1019.926	.1678-006	.3444-008	2.994	3.05	4.9374467	99.983
3.017	1419.930	1230.920	1019.924	.1712-006	.3413-008	3.055	3.12	4.9374422	99.982
2.715	1419.929	1230.919	1019.923	.1746-006	.3406-008	3.116	3.18	4.9374378	99.982
2.413	1419.927	1230.917	1019.921	.1780-006	.3444-008	3.177	3.24	4.9374334	99.982
2.112	1419.926	1230.916	1019.920	.1814-006	.3413-008	3.238	3.30	4.9374289	99.981
1.810	1419.925	1230.914	1019.918	.1849-006	.3429-008	3.299	3.37	4.9374244	99.981
1.508	1419.923	1230.913	1019.917	.1883-006	.3436-008	3.360	3.43	4.9374200	99.981
1.207	1419.922	1230.911	1019.915	.1917-006	.3421-008	3.421	3.49	4.9374155	99.980
.905	1419.920	1230.910	1019.913	.1952-006	.3429-008	3.482	3.55	4.9374111	99.980
.603	1419.919	1230.908	1019.912	.1986-006	.3413-008	3.544	3.61	4.9374066	99.980
.302	1419.918	1230.907	1019.910	.2020-006	.3421-008	3.605	3.68	4.9374022	99.979
.000	1419.916	1230.906	1019.909	.2054-006	.3406-008	3.666	3.74	4.9373978	99.979
-.302	1419.915	1230.904	1019.907	.2088-006	.3436-008	3.727	3.80	4.9373933	99.979
-1.098	1419.911	1230.900	1019.903	.2179-006	.1253-007	3.888	3.97	4.9373815	99.978
-2.245	1419.906	1230.895	1019.898	.2310-006	.1804-007	4.120	4.20	4.9373645	99.976
-3.896	1419.898	1230.887	1019.889	.2498-006	.2596-007	4.455	4.54	4.9373401	99.974
-6.274	1419.887	1230.875	1019.877	.2770-006	.3743-007	4.937	5.04	4.9373048	99.972
-9.699	1419.871	1230.859	1019.860	.3161-006	.5390-007	5.630	5.74	4.9372541	99.968
-14.630	1419.848	1230.835	1019.835	.3724-006	.7762-007	6.629	6.76	4.9371809	99.962
-21.730	1419.814	1230.801	1019.799	.4535-006	.1118-006	8.067	8.23	4.9370755	99.954
-31.956	1419.767	1230.752	1019.748	.5703-006	.1611-006	10.138	10.34	4.9369237	99.942
-46.680	1419.698	1230.681	1019.674	.7385-006	.2320-006	13.121	13.38	4.9367052	99.924
-67.882	1419.598	1230.580	1019.567	.9808-006	.3340-006	17.416	17.76	4.9363903	99.900
-98.414	1419.455	1230.433	1019.413	.1330-005	.4809-006	23.601	24.07	4.9359370	99.864
-142.380	1419.249	1230.222	1019.191	.1832-005	.6924-006	32.509	33.16	4.9352840	99.812
-205.691	1418.952	1229.918	1018.871	.2555-005	.9970-006	45.337	46.24	4.9343435	99.738
-296.859	1418.525	1229.479	1018.411	.3596-005	.1435-005	63.815	65.09	4.9329887	99.632
-428.141	1417.909	1228.848	1017.748	.5094-005	.2066-005	90.430	92.24	4.9310368	99.478
-617.187	1417.022	1227.939	1016.793	.7249-005	.2973-005	128.774	131.35	4.9282241	99.258
-889.412	1415.743	1226.628	1015.416	.1035-004	.4277-005	184.023	187.70	4.9241696	98.940
-1281.418	1413.900	1224.738	1013.431	.1481-004	.6150-005	263.655	268.93	4.9183226	98.484
-1845.905	1411.242	1222.013	1010.567	.2122-004	.8839-005	378.476	386.05	4.9098852	97.828
-2880.045	1406.358	1217.006	1005.306	.3291-004	.1170-004	589.267	601.05	4.8943759	96.630
-3905.953	1401.495	1212.019	1000.063	.4447-004	.1155-004	799.042	815.02	4.8789136	95.447
-5429.520	1394.238	1204.576	992.234	.6154-004	.1707-004	1111.811	1134.05	4.8558078	93.700
-6934.923	1387.026	1197.177	984.447	.7830-004	.1676-004	1422.322	1450.77	4.8328068	91.984
-8914.237	1377.478	1187.382	974.130	.1002-003	.2187-004	1832.851	1869.51	4.8023037	89.744

FIGURE 4-3. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	DROP DIAMETER AVERAGE (MICRO-M)	DROP DIAMETER MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	MASS LOST DUE TO EVAPORATION IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
-10378.080	1370.368	1180.087	966.443	.1162-003	.1606-004	2138.154	2180.92	4.7795514	98.100

FIGURE 4-3. (Continued)

TABLE 2 (CONT.)
- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -

- CALCULATED EQUATIONS FOR DROP SIZE CATEGORY 1 (1020.000 - 1420.000 MICRO-M) -

SETTLING VELOCITY AS A FUNCTION OF DISTANCE
VS(MPS) = .49376656+001 + -.71841217-004 *X+ -.30143473-009 *X**2

HEIGHT AS A FUNCTION OF DISTANCE
H(M) = .18119107+002 + -.48426686+001 *X+ .34569162-004 *X**2

FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
FRACT = .99978900+000 + .11697134-004 *H+ .24207153-010 *H**2

TIME AS A FUNCTION OF HEIGHT
TIME(SEC) = .36692189+001 + -.20243053+000 *H+ .30951647-006 *H**2

DROP DIAMETER AS A FUNCTION OF TIME
DROP(MICRO-M) = .12309922+004 + -.23706743-001 *T+ -.47505991-007 *T**2

FIGURE 4-3. (Continued)

TABLE 3
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

```
VAPOR PRESSURE OF LIQUID AT INFINITY = .16276310+002 (MB)
AIR DENSITY = .12200585-002 (G/CM**3)
MOLAL CONCENTRATION OF AIR-LIQUID MIXTURE = .42122692-004 (G/CM**3)
DIFFUSIVITY OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE = .23294216+000 (CM**2/SEC)
THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP TEMPERATURE = .59880651-004 (CAL/(SEC.CM.DEGREE K))
LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE = .59086238+003 (CAL/MOLE)
DROP PRESSURE = .16340134+002 (MB)
DROP TEMPERATURE = .14290404+002 (DEGREES C)
WAKE SETTLING VELOCITY = .54999816+000 (M/S)
ABSOLUTE VISCOSITY (GM/CM/SEC) = .12499794-003
SCHMIDT NUMBER = .43981910+000
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FIGURE 4-3. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
12.000	1419.972	1230.963	1019.970	.6848-007	.0000	1.222	1.25	4.9375756	99.993
11.800	1419.971	1230.962	1019.969	.7076-007	.2286-008	1.262	1.28	4.9375727	99.993
11.600	1419.970	1230.961	1019.968	.7305-007	.2286-008	1.303	1.32	4.9375696	99.993
11.400	1419.969	1230.960	1019.967	.7533-007	.2278-008	1.343	1.36	4.9375667	99.992
11.200	1419.968	1230.959	1019.966	.7761-007	.2286-008	1.384	1.39	4.9375637	99.992
11.000	1419.967	1230.958	1019.965	.7987-007	.2263-008	1.424	1.43	4.9375607	99.992
10.800	1419.966	1230.957	1019.964	.8215-007	.2278-008	1.465	1.47	4.9375578	99.992
10.600	1419.965	1230.956	1019.963	.8441-007	.2263-008	1.505	1.50	4.9375549	99.991
10.400	1419.965	1230.955	1019.962	.8669-007	.2278-008	1.546	1.54	4.9375520	99.991
10.200	1419.964	1230.954	1019.961	.8898-007	.2286-008	1.586	1.57	4.9375490	99.991
10.000	1419.963	1230.954	1019.960	.9124-007	.2263-008	1.627	1.61	4.9375460	99.991
9.800	1419.962	1230.953	1019.959	.9353-007	.2286-008	1.667	1.65	4.9375430	99.990
9.600	1419.961	1230.952	1019.958	.9579-007	.2263-008	1.708	1.68	4.9375402	99.990
9.400	1419.960	1230.951	1019.957	.9808-007	.2286-008	1.748	1.72	4.9375371	99.990
9.200	1419.959	1230.950	1019.956	.1003-006	.2271-008	1.789	1.76	4.9375342	99.990
9.000	1419.958	1230.949	1019.955	.1026-006	.2263-008	1.829	1.79	4.9375312	99.989
8.800	1419.957	1230.948	1019.954	.1049-006	.2286-008	1.870	1.83	4.9375283	99.989
8.600	1419.956	1230.947	1019.953	.1072-006	.2286-008	1.911	1.86	4.9375253	99.989
8.400	1419.955	1230.946	1019.952	.1094-006	.2263-008	1.951	1.89	4.9375224	99.989
8.200	1419.954	1230.945	1019.951	.1117-006	.2278-008	1.992	1.93	4.9375194	99.989
8.000	1419.953	1230.944	1019.950	.1140-006	.2286-008	2.032	1.96	4.9375165	99.988
7.800	1419.952	1230.943	1019.949	.1163-006	.2278-008	2.073	1.99	4.9375135	99.988
7.600	1419.952	1230.942	1019.947	.1185-006	.2263-008	2.113	2.03	4.9375106	99.988
7.400	1419.951	1230.941	1019.946	.1208-006	.2263-008	2.154	2.06	4.9375076	99.988
7.200	1419.950	1230.940	1019.945	.1231-006	.2286-008	2.194	2.09	4.9375046	99.987
7.000	1419.949	1230.939	1019.944	.1254-006	.2278-008	2.235	2.13	4.9375017	99.987
6.800	1419.948	1230.938	1019.943	.1276-006	.2263-008	2.275	2.16	4.9374987	99.987
6.600	1419.947	1230.937	1019.942	.1299-006	.2286-008	2.316	2.19	4.9374958	99.987
6.400	1419.946	1230.936	1019.941	.1322-006	.2286-008	2.356	2.22	4.9374928	99.986
6.200	1419.945	1230.935	1019.940	.1345-006	.2278-008	2.397	2.26	4.9374899	99.986
6.000	1419.944	1230.934	1019.939	.1367-006	.2255-008	2.437	2.29	4.9374869	99.986
5.800	1419.943	1230.933	1019.938	.1390-006	.2286-008	2.478	2.33	4.9374840	99.986
5.600	1419.942	1230.932	1019.937	.1413-006	.2286-008	2.518	2.36	4.9374810	99.986
5.400	1419.941	1230.932	1019.936	.1436-006	.2263-008	2.559	2.39	4.9374781	99.985
5.200	1419.940	1230.931	1019.935	.1459-006	.2286-008	2.599	2.43	4.9374751	99.985
5.000	1419.939	1230.930	1019.934	.1481-006	.2278-008	2.640	2.46	4.9374721	99.985
4.800	1419.938	1230.929	1019.933	.1504-006	.2263-008	2.680	2.50	4.9374692	99.985
4.600	1419.938	1230.928	1019.932	.1527-006	.2278-008	2.721	2.53	4.9374663	99.984
4.400	1419.937	1230.927	1019.931	.1550-006	.2286-008	2.761	2.56	4.9374633	99.984
4.200	1419.936	1230.926	1019.930	.1573-006	.2286-008	2.802	2.60	4.9374603	99.984
4.000	1419.935	1230.925	1019.929	.1595-006	.2255-008	2.842	2.63	4.9374574	99.984
3.800	1419.934	1230.924	1019.928	.1618-006	.2286-008	2.883	2.67	4.9374544	99.983
3.600	1419.933	1230.923	1019.927	.1641-006	.2263-008	2.923	2.70	4.9374514	99.983

FIGURE 4-3. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

DROP HEIGHT (METERS)	DROP DIAMETER MAXIMUM (MICRO-M)	AVERAGE (MICRO-M)	MINIMUM (MICRO-M)	MASS LOST DUE TO EVAPORATION TOTAL (GRAMS)	IN DH (GRAMS)	FALL TIME (SEC)	ALONGWIND DISTANCE (METERS)	SETTLING VELOCITY (M/S)	PERCENT MATERIAL REACHING HEIGHT
3.400	1419.932	1230.922	1019.926	.1663-006	.2286-008	2.964	2.73	4.9374485	99.983
3.200	1419.931	1230.921	1019.925	.1686-006	.2255-008	3.004	2.77	4.9374455	99.983
3.000	1419.930	1230.920	1019.924	.1709-006	.2278-008	3.045	2.80	4.9374425	99.982
2.800	1419.929	1230.919	1019.923	.1732-006	.2286-008	3.085	2.84	4.9374396	99.982
2.600	1419.928	1230.918	1019.922	.1755-006	.2286-008	3.126	2.88	4.9374366	99.982
2.400	1419.927	1230.917	1019.921	.1777-006	.2263-008	3.166	2.92	4.9374337	99.982
2.200	1419.926	1230.916	1019.920	.1800-006	.2286-008	3.207	2.96	4.9374307	99.982
2.000	1419.925	1230.915	1019.919	.1823-006	.2255-008	3.247	2.99	4.9374278	99.981
1.800	1419.925	1230.914	1019.918	.1845-006	.2286-008	3.288	3.03	4.9374248	99.981
1.600	1419.924	1230.913	1019.917	.1868-006	.2278-008	3.328	3.07	4.9374219	99.981
1.400	1419.923	1230.912	1019.916	.1891-006	.2263-008	3.369	3.11	4.9374190	99.981
1.200	1419.922	1230.911	1019.915	.1914-006	.2286-008	3.409	3.15	4.9374160	99.980
1.000	1419.921	1230.910	1019.914	.1936-006	.2278-008	3.450	3.19	4.9374130	99.980
.800	1419.920	1230.910	1019.913	.1959-006	.2286-008	3.490	3.23	4.9374101	99.980
.600	1419.919	1230.909	1019.912	.1982-006	.2263-008	3.531	3.26	4.9374072	99.980
.400	1419.918	1230.908	1019.911	.2005-006	.2286-008	3.571	3.30	4.9374042	99.979
.200	1419.917	1230.907	1019.910	.2028-006	.2278-008	3.612	3.34	4.9374012	99.979
.000	1419.916	1230.906	1019.909	.2050-006	.2255-008	3.652	3.38	4.9373983	99.979
-.200	1419.915	1230.905	1019.908	.2073-006	.2286-008	3.693	3.42	4.9373953	99.979

FIGURE 4-3. (Continued)

TABLE 3 (CONT.)
- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -

- CALCULATED EQUATIONS FOR DROP SIZE CATEGORY 1 (1019.970 - 1419.972 MICRO-M) -

SETTLING VELOCITY AS A FUNCTION OF HEIGHT
VS(MPS) = .49373983+001 + .14773079-004 *H+ .11027818-009 *H**2

HEIGHT AS A FUNCTION OF DISTANCE
H(M) = .11926300+002 + -.59956063+001 *X+ .12372368+000 *X**2

DISTANCE AS A FUNCTION OF HEIGHT
X(M) = .20776707+001 + -.18199798+000 *H+ .65906207-003 *H**2

FRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HEIGHT
FRACT = .99986250+000 + .11651691-004 *H+ -.14707762-009 *H**2

DROP DIAMETER AS A FUNCTION OF HEIGHT
DROP(MICROM) = .12309057+004 + .47817502-002 *H+ -.10877131-006 *H**2

DROP DIAMETER AS A FUNCTION OF TIME
DROP(MICROM) = .12309919+004 + -.23591295-001 *T+ -.24819962-005 *T**2

FIGURE 4-3. (Continued)

TABLE 4
- CALCULATED VALUES FROM CANOPY PENETRATION MODEL -

DROP SIZE CATEGORY	FRACTION/DISTANCE OF MATERIAL REACHING INDICATED HEIGHT											
	HGT= 12.0 M		HGT= 10.8 M		HGT= 9.6 M		HGT= 8.4 M		HGT= 7.2 M		HGT= 6.0 M	
	FRACT	DIST(M)	FRACT	DIST(M)	FRACT	DIST(M)	FRACT	DIST(M)	FRACT	DIST(M)	FRACT	DIST(M)
1	1.00000	.0	.69800	.2	.62600	.4	.52400	.6	.37200	.8	.37200	1.0
2	1.00000	.0	.72000	.2	.66800	.5	.57400	.8	.43600	1.0	.43600	1.3
3	1.00000	.0	.74400	.3	.69600	.6	.61200	.9	.44400	1.2	.44400	1.5
4	1.00000	.0	.73200	.3	.68400	.6	.60800	1.0	.47600	1.3	.47600	1.6
5	1.00000	.0	.67800	.4	.61400	.7	.54600	1.1	.41800	1.5	.41800	1.8
6	1.00000	.0	.80600	.4	.73400	.8	.64200	1.3	.51800	1.7	.51200	2.1
7	1.00000	.0	.81400	.5	.74600	1.0	.64400	1.4	.51400	1.9	.51200	2.4
8	1.00000	.0	.84200	.6	.79000	1.1	.67600	1.7	.51400	2.3	.47800	2.9
9	1.00000	.0	.88800	.7	.82000	1.4	.73400	2.1	.62200	2.8	.53400	3.5
10	1.00000	.0	.93200	.8	.86600	1.7	.78800	2.5	.67200	3.3	.55000	4.2
11	1.00000	.0	1.00000	1.1	.94000	2.1	.81400	3.2	.68600	4.3	.57800	5.5
12	1.00000	.0	.87800	1.3	.79000	2.7	.69200	4.0	.59400	5.4	.50400	6.8
13	1.00000	.0	.99200	1.7	.91200	3.4	.79400	5.1	.69600	6.8	.61000	8.5
14	1.00000	.0	.92200	2.5	.85000	5.0	.77200	7.5	.68400	10.0	.63000	12.6
15	1.00000	.0	.97200	4.7	.91800	9.4	.84800	14.2	.80000	19.2	.73600	24.1
16	1.00000	.0	.26000	64.2	.00000	220.4	.00000	468.6	.00000	808.8	.00000	1241.0

DROP SIZE CATEGORY	FRACTION/DISTANCE OF MATERIAL REACHING INDICATED HEIGHT									
	HGT= 4.8 M		HGT= 3.6 M		HGT= 2.4 M		HGT= 1.2 M		HGT= .0 M	
	FRACT	DIST(M)	FRACT	DIST(M)	FRACT	DIST(M)	FRACT	DIST(M)	FRACT	DIST(M)
1	.30600	1.2	.30600	1.4	.30600	1.7	.30600	1.9	.30600	2.1
2	.34800	1.5	.34800	1.8	.34800	2.1	.34800	2.3	.34800	2.6
3	.33800	1.8	.33800	2.1	.33800	2.4	.33800	2.7	.33800	3.0
4	.35400	2.0	.35400	2.3	.35400	2.6	.35400	3.0	.35400	3.3
5	.33000	2.2	.33000	2.6	.33000	3.0	.33000	3.4	.33000	3.8
6	.38800	2.6	.38800	3.0	.38800	3.5	.38800	3.9	.38800	4.4
7	.41000	2.9	.41000	3.4	.41000	3.9	.41000	4.5	.41000	5.0
8	.36800	3.5	.36800	4.1	.36800	4.7	.36800	5.3	.36800	5.9
9	.37400	4.2	.37400	4.9	.37400	5.7	.37400	6.4	.37400	7.2
10	.36800	5.1	.33000	5.9	.33000	6.8	.33000	7.7	.33000	8.6
11	.41400	6.6	.32400	7.7	.30800	8.9	.30800	10.0	.30800	11.2
12	.38600	8.2	.32400	9.6	.31000	11.0	.31000	12.5	.30800	13.9
13	.56200	10.3	.52400	12.1	.51800	13.9	.51800	15.7	.51800	17.5
14	.56600	15.2	.53800	17.8	.52800	20.5	.52800	23.2	.52800	25.9
15	.71000	29.2	.68000	34.3	.67600	39.5	.67600	44.8	.67600	50.2
16	.00000	1765.3	.00000	2381.6	.00000	3090.0	.00000	3890.3	.00000	4782.7

FIGURE 4-3. (Continued)

TABLE 5

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	- X AXIS (METERS) - -82.30	-81.40	-80.50	-79.60	-78.60	-77.70	-76.80	-75.90	-75.00
	- DEPOSITION -								
153.20	.206238+006	.202115+006	.203213+006	.205261+006	.206019+006	.207985+006	.213043+006	.213663+006	.218987+006

Y AXIS (METERS)	- X AXIS (METERS) - -74.10	-73.20	-72.20	-71.30	-70.40	-69.50	-68.60	-67.70	-66.80
	- DEPOSITION -								
153.20	.212073+006	.203174+006	.198979+006	.200708+006	.203121+006	.204133+006	.206073+006	.211251+006	.217335+006

Y AXIS (METERS)	- X AXIS (METERS) - -65.80	-64.90	-64.00	-63.10	-62.20	-61.30	-60.40	-59.40	-58.50
	- DEPOSITION -								
153.20	.218262+006	.211396+006	.202440+006	.198056+006	.198865+006	.200595+006	.200937+006	.202431+006	.207150+006

Y AXIS (METERS)	- X AXIS (METERS) - -57.60	-56.70	-55.80	-54.90	-53.90	-53.00	-52.10	-51.20	-50.30
	- DEPOSITION -								
153.20	.212278+006	.212052+006	.204519+006	.194920+006	.189837+006	.190650+006	.192015+006	.191822+006	.192370+006

Y AXIS (METERS)	- X AXIS (METERS) - -49.40	-48.50	-47.50	-46.60	-45.70	-44.80	-43.90	-43.00	-42.10
	- DEPOSITION -								
153.20	.195935+006	.200136+006	.198588+006	.189073+006	.176977+006	.168953+006	.165190+006	.161549+006	.155426+006

FIGURE 4-3. (Continued)

TABLE 5 (CONT.)

- DEPOSITION (DROPS /SQUARE METER) *-*
- AT A HEIGHT OF .0000 METERS *-*
(MAXIMUM DEPOSITION = .2189868+006 AT X= -75.000, Y= 153.200)

Y AXIS (METERS)	- X AXIS (METERS) - DEPOSITION - -41.10	-40.20	-39.30	-38.40	-37.50	-36.60
153.20	.148175+006	.143339+006	.137056+006	.123364+006	.100274+006	.733324+005

FIGURE 4-3. (Continued)

used by the canopy penetration model and dispersion models, respectively. The ***** symbols are also used on these pages to show parameters that are to be calculated by the program. Pages 4 through 111 are printed only if the parameter ISW(5) is set non-zero. In this example, only pages 4 through 7 and 63 through 66 (upper right corner) are shown. Page 4 gives calculated parameters used by the evaporation model. Pages 5 through 7 show the above canopy evaporation calculations for drop-size category 1. A set of pages similar to pages 5 through 7 are printed for each drop size category for above canopy evaporation. The program prints the height, the maximum, mean and minimum drop diameter, the total mass lost to evaporation, the mass lost to evaporation in the height interval, the fall time, the horizontal travel distance, the settling velocity and the percent of spray material reaching the given height as drops. This information is printed down the page until the minimum drop diameter of 2 micrometers is achieved, or the drop is essentially evaporated or until the height falls to -10000 meters. The evaporation is calculated until these criteria are met because the FSCBG program requires the complete curve of evaporation in order to calculate the equations of height versus distance, drop size versus distance, etc. above the canopy. The last page for each drop size category (page 7) details the equations required by the canopy penetration model and dispersion models. Pages 63 through 66 (upper right corner) are the same in content as pages 5 through 7, except these pages give the evaporation detail below the canopy for drop-size category 1. The below-canopy evaporation calculations are stopped at the ground and are not made for negative heights as in the case for the above-canopy evaporation calculations. Page 112 (upper right corner) of Figure 4-3 shows the output from the canopy penetration model and is obtained by the ISW(3) option. For each drop-size category, the FSCBG program prints the fraction of drops reaching each 10th of the forest canopy height. The fraction of drop material printed here accounts for losses due to evaporation and losses due to impaction in the upper areas of the canopy. Note that drop size category 16 only reaches the 10.8 meter level. This

is because the drop evaporates before it can penetrate any deeper into the canopy. Also, the horizontal travel distance required for drops in each category to reach each 10th of the forest canopy height is printed. Pages 113 and 114 (upper right corner) of Figure 4-3 show the ground level deposition calculated for this example problem. The output displays "DEPOSITION", the output units, the maximum calculated value and location followed by the deposition at each input receptor point. A listing of dosage or concentration would appear in the same format.

The FSCBG program has also been used to calculate deposition occurring along the sampling line shown in Figure 4-1 for relative humidities of 70 and 50 percent, with all other model inputs described in Section 4.1 remaining the same. The results of the ground-level deposition for all three humidity values are shown in Figure 4-4.

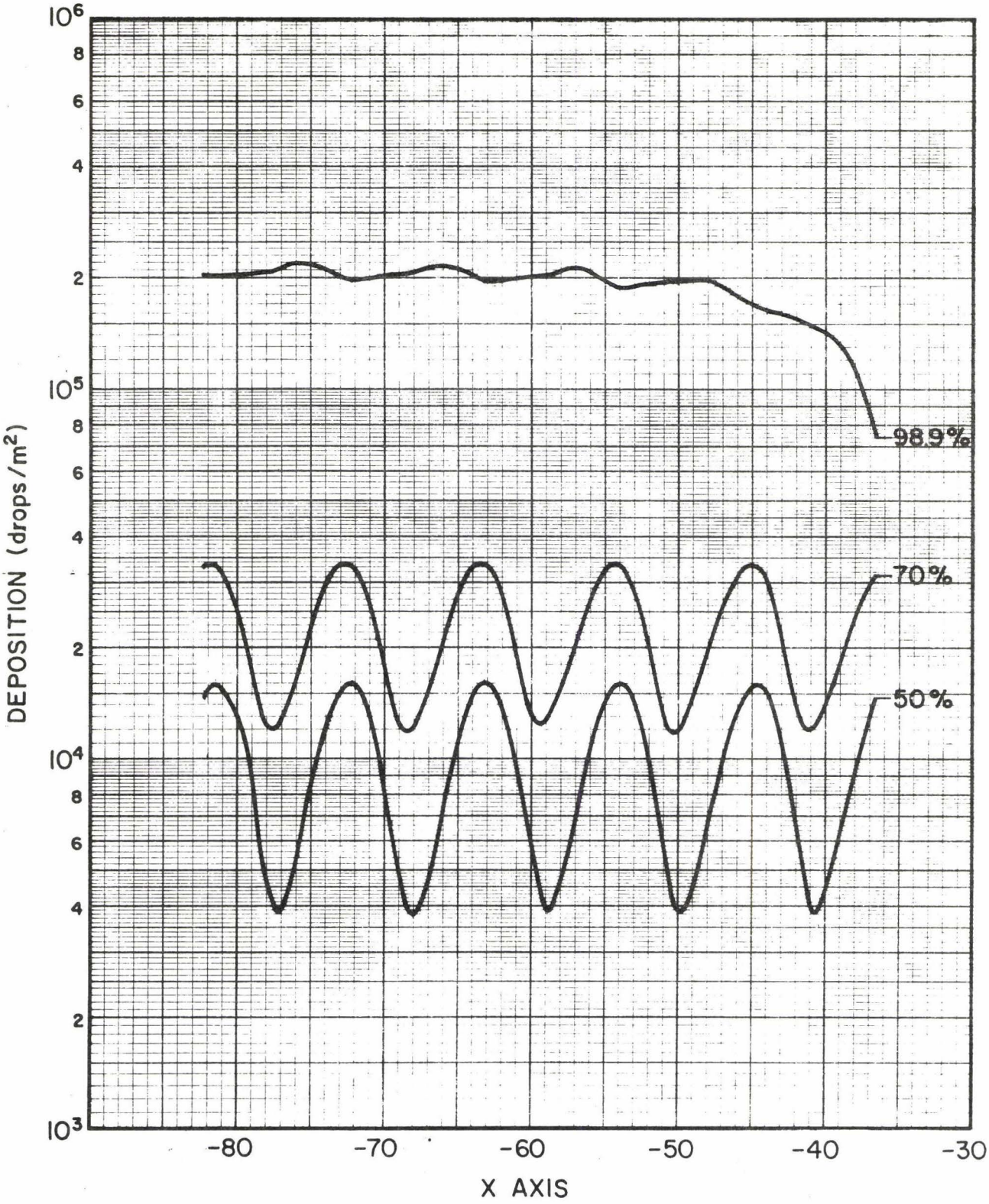

FIGURE 4-4. Results of the example deposition calculation for relative humidities of 98.9, 70 and 50 percent.

```
      C     VERSION 1, SEPT 1980, BJORKLUND, H. E. CRAMER CO. INC.                S0100010
      C                                                                           S0100020
      C                                                                           S0100030
      C     THIS PROGRAM IS DESIGNED TO CALCULATE DOSAGE AND CONCENTRATION        S0100040
      C     ABOVE A FOREST CANOPY AND DEPOSITION ABOVE OR BELOW A FOREST          S0100050
      C     CANOPY DOWNWIND OF MULTIPLE LINE SOURCES DEFINED BY AIRCRAFT          S0100060
      C     SPRAY LINES. ALSO, THIS PROGRAM HAS THE CAPABILITY OF ACCOUNTING      S0100070
      C     FOR LOSS OF SPRAY MATERIAL DUE TO EVAPORATION AND THE LOSS OF         S0100080
      C     MATERIAL DUE TO IMPACTION WITHIN THE FOREST CANOPY, WHERE FOREST      S0100090
      C     CANOPY IS DEFINED TO BE ANY ABOVE GROUND VEGETATION.                  S0100100
      C                                                                           S0100110
      C                                                                           S0100120
      C                                                                           S0100130
            COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40),     S0100140
     *ISW(20),I,J,K,L,M,N,NVS                                                     S0100150
            COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),                   S0100160
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,             S0100170
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),             S0100180
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),             S0100190
     *CN1D(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),             S0100200
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1                S0100210
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DFLU,CONV(20)                       S0100220
            COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,       S0100230
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRUT,ARCRSP,AIRTPO,AIRDEN,                    S0100240
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),                   S0100250
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TRFDEN(3),                S0100260
     *TRPENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),               S0100270
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,                 S0100280
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,             S0100290
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),             S0100300
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,IIMO(20),               S0100310
     *TMISO(20),RDST(20),XLOCS(20),                                             S0100320
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),          S0100330
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                               S0100340
            INTEGER TITLE                                                       S0100350
      C                                                                         S0100360
      C                                                                         S0100370
      C                                                                         S0100380
```

```
C*****************- FSCBG REQUIRED INPUT DATA -***- DEFAULT VALUES ARE    S0100390
C       PROVIDED ONLY IF THE RESPECTIVE INPUT PARAMETER IS OMITTED          S0100400
C       FROM THE INPUT DATA.                                                S0100410
C                                                                           S0100420
C     TITLE - CASE TITLING INFORMATION. A MAXIMUM OF 80 CHARACTERS MAY      S0100430
C             BE INPUT. IF NOT INPUT THE TITLE IS DEFAULTED TO BLANKS.      S0100440
C                                                                           S0100450
C     ISW - FSCBG PROGRAM OPTION ARRAY.                                     S0100460
C         ISW(1) - WAKE SETTLING VELOCITY OPTION.                           S0100470
C                  IF = 0, THE PROGRAM ASSUMES THE WAKE SETTLING            S0100480
C                          VELOCITY WAKVEL IS BEING INPUT.                  S0100490
C                  IF = 1, THE PROGRAM ASSUMES THE WAKE SETTLING            S0100500
C                          VELOCITY IS TO BE CALCULATED FROM THE INPUT      S0100510
C                          PARAMETERS - ARCRWT, AIRDEN, WNGSPN AND          S0100520
C                          ARCRSP.                                          S0100530
C         ISW(2) - EVAPORATION MODEL OPTION.                                S0100540
C                  IF = 0, THE EVAPORATION MODEL IS NOT EXECUTED. THE       S0100550
C                          PROGRAM ASSUMES THERE IS NO CHANGE IN DROP       S0100560
C                          SIZE WITH TIME.                                  S0100570
C                  IF = 1, THE EVAPORATION MODEL IS EXECUTED. THE           S0100580
C                          PROGRAM CALCULATES THE RATE OF CHANGE OF         S0100590
C                          DROP SIZE WITH TIME FOR BOTH ABOVE AND BELOW     S0100600
C                          THE CANOPY.                                      S0100610
C                  IF = 2, THE EVAPORATION MODEL IS NOT EXECUTED. THE       S0100620
C                          PROGRAM ASSUMES THE USER INPUTS THE EQUATIONS    S0100630
C                          OF THE RATE OF CHANGE OF DROP SIZE WITH TIME     S0100640
C                          FOR BOTH ABOVE AND BELOW THE CANOPY.             S0100650
C         ISW(3) - CANOPY PENETRATION MODEL OPTION.                         S0100660
C                  IF = 0, THE CANOPY PENETRATION MODEL IS NOT EXECUTED.    S0100670
C                  IF = 1, THE CANOPY PENETRATION MODEL IS EXECUTED.        S0100680
C                          THE PROGRAM CALCULATES THE PERCENTAGE OF THE     S0100690
C                          RELEASED MATERIAL THAT REACHES THE 10THS OF      S0100700
C                          THE FOREST CANOPY HEIGHT FOR EACH DROP SIZE      S0100710
C                          CATEGORY.                                        S0100720
C                  IF = 2, THE SAME AS 1, PLUS CANOPY PENETRATION MODEL     S0100730
C                          CALCULATIONS ARE PRINTED.                        S0100740
C                  IF = 3, THE SAME AS 2, PLUS DEBUG CALCULATIONS ARE       S0100750
C                          PRINTED. ONLY USE ONE DROP SIZE CATEGORY DUE     S0100760
```

```
77*      C                        TO THE LARGE VOLUME OF PRINT OUTPUT.          S0100770
78*      C          ISW(4) - DISPERSION MODELS OPTION.                          S0100780
79*      C                   IF = 0, THE DISPERSION MODELS ARE NOT EXECUTED.    S0100790
80*      C                   IF = 1, THE DISPERSION MODELS ARE EXECUTED, PRODUCINGS0100800
81*      C                        DOSAGE, CONCENTRATION AND/OR DEPOSITION       S0100810
92*      C                        DEPENDING ON ISW(6), ISW(7) AND/OR ISW(8),    S0100820
93*      C                        RESPECTIVELY.                                 S0100830
94*      C                   IF = 2, THE SAME AS 1, PLUS DEBUG CALCULATIONS ARE S0100840
35*      C                        PRINTED. ONLY USE ONE DROP SIZE CATEGORY,     S0100850
96*      C                        FEW SOURCES AND FEW RECEPTORS DUE TO THE      S0100860
97*      C                        LARGE VOLUME OF PRINT OUTPUT.                 S0100870
88*      C          ISW(5) - PRINT EVAPORATION MODEL (ISW(2)) CALCULATIONS OPTION.S0100880
89*      C                   IF = 0, EVAPORATION MODEL CALCULATIONS ARE NOT     S0100890
90*      C                        PRINTED. THIS INCLUDES ALL CALCULATIONS UNDERS0100900
91*      C                        ISW(2).                                       S0100910
92*      C                   IF = 1, THE EVAPORATION MODEL CALCULATIONS ARE     S0100920
93*      C                        PRINTED. THIS INCLUDES ALL CALCULATIONS UNDERS0100930
94*      C                        ISW(2).                                       S0100940
95*      C                   IF = 2, THE SAME AS 1, PLUS DEBUG CALCULATIONS ARE S0100950
96*      C                        PRINTED. ONLY USE A FEW DROP SIZE CATEGORIES  S0100960
97*      C                        DUE TO THE LARGE VOLUME OF PRINT OUTPUT.      S0100970
98*      C          ISW(6) - DOSAGE MODEL OPTION.                               S0100980
99*      C                   IF = 0, THE DOSAGE IS NOT CALCULATED.              S0100990
100*     C                   IF = 1, THE DOSAGE IS CALCULATED AND PRINTED. NOTE S0101000
101*     C                        THAT DOSAGE CAN ONLY BE CALCULATED AT HEIGHT  S0101010
102*     C                        Z GREATER THAN OR EQUAL TO THE HEIGHT OF THE  S0101020
103*     C                        CANOPY HGTCAN AND LESS THAN THE HEIGHT OF THESS0101030
104*     C                        AIRCRAFT.                                     S0101040
105*     C          ISW(7) - CONCENTRATION MODEL OPTION.                        S0101050
106*     C                   IF = 0, THE CONCENTRATION IS NOT CALCULATED.       S0101060
107*     C                   IF = 1, THE CONCENTRATION IS CALCULATED AND PRINTED S0101070
108*     C                        NOTE THAT CONCENTRATION CAN ONLY BE           S0101080
109*     C                        CALCULATED AT HEIGHT Z GREATER THAN OR EQUAL  S0101090
110*     C                        TO THE HEIGHT OF THE CANOPY HGTCAN AND LESS   S0101100
111*     C                        THAN THE HEIGHT OF THE AIRCRAFT.              S0101110
112*     C          ISW(8) - DEPOSITION MODEL OPTION.                           S0101120
113*     C                   IF = 0, THE DEPOSITION IS NOT CALCULATED.          S0101130
114*     C                   IF = 1, THE DEPOSITION IS CALCULATED AND PRINTED.  S0101140
```

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115*      C                    DEPOSITION CAN BE CALCULATED AT ANY HEIGHT Z S0101150
116*      C                    LESS THAN THE HEIGHT OF THE AIRCRAFT HGTCFT  S0101160
117*      C                    AND GREATER THAN OR EQUAL TO 0 (GROUND).     S0101170
118*      C          ISW(9) - DOSAGE, CONCENTRATION, DEPOSITION OUTPUT UNITS S0101180
119*      C                   CONVERSION OPTION. THIS OPTION ASSUMES THAT THE S0101190
120*      C                   EMISSION RATE Q IS INPUT IN GRAMS/METER IF SWATH S0101200
121*      C                   IS INPUT AS 0. OTHERWISE Q IS ASSUMED TO BE IN S0101210
122*      C                   GALLONS/ACRE WHEN SWATH IS INPUT NON-ZERO.     S0101220
123*      C                   ALL UNITS CONVERSION IS HANDLED AUTOMATICALLY BY THE S0101230
124*      C                   PROGRAM.                                       S0101240
125*      C                   IF = 0, PRINT UNITS ARE DROPS. (VAPOR DOSAGE AND S0101250
126*      C                           CONCENTRATION ARE NOT INCLUDED IN THE  S0101260
127*      C                           CALCULATION WHEN ISW(9) = 0)           S0101270
128*      C                   IF = 1, PRINT UNITS ARE MICROGRAMS.            S0101280
129*      C                   IF = 2, PRINT UNITS ARE MILLIGRAMS.            S0101290
130*      C                   IF = 3, PRINT UNITS ARE GRAMS.                 S0101300
131*      C                   IF = 4, PRINT UNITS ARE OUNCES.                S0101310
132*      C                   IF = 5, PRINT UNITS ARE POUNDS.                S0101320
133*      C          ISW(10)- DOSAGE PRINT TIME UNITS OPTION. THE PROGRAM ASSUMES S0101330
134*      C                   ALL INPUT TIME UNITS ARE SECONDS.              S0101340
135*      C                   IF = 0, PRINT UNITS ARE SECONDS (GRAM SECONDS/M**3). S0101350
136*      C                   IF = 1, PRINT UNITS ARE MINUTES (GRAM MINUTES/M**3). S0101360
137*      C          ISW(11)- DOSAGE, CONCENTRATION, DEPOSITION PRINT VOLUME OR S0101370
138*      C                   AREA LENGTH UNITS OPTION.                      S0101380
139*      C                           DOSAGE CONCENTRATION DEPOSITION AREA-COVERAGES0101390
140*      C                   IF = 0,  M**3       M**3        M**2        M**2 S0101400
141*      C                   IF = 1, FT**3      FT**3       FT**2       FT**2 S0101410
142*      C                   IF = 2,  M**3       M**3        ACRE        ACRE S0101420
143*      C                   IF = 3, FT**3      FT**3        ACRE        ACRE S0101430
144*      C                   IF = 4,  M**3       M**3     HECTARES    HECTARES S0101440
145*      C          ISW(12)- AREA OF COVERAGE OPTION.                       S0101450
146*      C                   IF = 0, AREA OF COVERAGE IS NOT CALCULATED.    S0101460
147*      C                   IF = 1, AREA OF COVERAGE OF DOSAGE, CONCENTRATION S0101470
148*      C                           AND/OR DEPOSITION IS CALCULATED DEPENDING ON S0101480
149*      C                           DOSLV, CONLV AND/OR DEPLV, RESPECTIVELY. S0101490
150*      C                           THE AREA OF COVERAGE IS THAT TOTAL AREA OR S0101500
151*      C                           AREAS COVERED BY THE GIVEN LEVELS OF DOSAGE, S0101510
152*      C                           CONCENTRATION AND/OR DEPOSITION IN DOSLV, S0101520
```

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153*      C                          CONLV AND/OR DEPLV.                                  S0101530
154*      C          ISW(13)-ISW(20)- RESERVED FOR FUTURE OPTIONS.                        S0101540
155*      C                                                                               S0101550
156*      C      IFWATR - SWITCH USED TO INFORM THE PROGRAM OF WHETHER WATER OR A         S0101560
157*      C               NON-WATER BASE LIQUID IS TO BE MODELED (DEFAULT=1).             S0101570
158*      C               IF = 2, THE PROGRAM ASSUMES THE DROPS ARE NON-WATER BASE.       S0101580
159*      C               IF = 1, THE PROGRAM ASSUMES THE DROPS ARE WATER BASE.           S0101590
160*      C                                                                               S0101600
161*      C      WNGSPN - AIRCRAFT WING SPAN OR HELICOPTER ROTOR DIAMETER IN METERS       S0101610
162*      C               (NO DEFAULT).                                                   S0101620
163*      C                                                                               S0101630
164*      C      WSOCAN - WIND SPEED IN METERS/SEC ABOVE THE CANOPY (NO DEFAULT).         S0101640
165*      C                                                                               S0101650
166*      C      HGTCFT - HEIGHT ABOVE THE GROUND OF THE AIRCRAFT IN METERS (NO           S0101660
167*      C               DEFAULT).                                                       S0101670
168*      C                                                                               S0101680
169*      C      DENLIQ - DENSITY OF THE DROP LIQUID IN GRAMS/CM**3 (DEFAULT=1.0)         S0101690
170*      C                                                                               S0101700
171*      C      AIRTPO - AIR TEMPERATURE IN DEGREES CELCIUS ABOVE THE CANOPY (NO         S0101710
172*      C               DEFAULT).                                                       S0101720
173*      C                                                                               S0101730
174*      C      AIRTPU - AIR TEMPERATURE IN DEGREES CELCIUS BELOW THE CANOPY             S0101740
175*      C               (DEFAULT=AIRTPO).                                               S0101750
176*      C                                                                               S0101760
177*      C      AIRDEN - AIR DENSITY IN GRAMS/CM**3. IF NOT INPUT THEN YOU MUST          S0101770
178*      C               INPUT AIRMOL, AIRPRS AND VAPINF. IF VAPINF IS NOT INPUT         S0101780
179*      C               OR IFWATR EQUALS 1 THEN YOU MUST INPUT RELHMO AND RELHMU        S0101790
190*      C               RATHER THAN VAPINF. THESE PARAMETERS ARE DEFINED BELOW.         S0101800
181*      C                                                                               S0101810
192*      C***************- INPUTS DEPENDING ON ISW(1)                                   S0101820
183*      C                                                                               S0101830
194*      C-IF ISW(1) = 0                                                                 S0101840
185*      C                                                                               S0101850
196*      C      WAKVEL - WAKE SETTLING VELOCITY IN METERS/SEC (NO DEFAULT).              S0101860
187*      C                                                                               S0101870
188*      C-IF ISW(1) = 1                                                                 S0101880
189*      C                                                                               S0101890
190*      C      ARCRWT - AIRCRAFT WEIGHT IN KILOGRAMS (NO DEFAULT).                      S0101900
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191*      C                                                                      S0101910
192*      C     ARCRSP - AIRCRAFT GROUND SPEED IN METERS/SEC (NO DEFAULT).       S0101920
193*      C                                                                      S0101930
194*      C****************- INPUTS DEPENDING ON ISW(2)                         S0101940
195*      C                                                                      S0101950
196*      C-IF ISW(2) = 0 OR 1                                                   S0101960
197*      C                                                                      S0101970
198*      C     DRPUPR - ARRAY CONTAINING THE INITIAL UPPER LIMITS TO THE DROP   S0101980
199*      C              DIAMETER IN MICROMETERS OF EACH DROP SIZE CATEGORY. THERES0101990
200*      C              ARE A MAXIMUM OF 20 DROP SIZE CATEGORIES. VALUES INPUT  S0102000
201*      C              TO DRPUPR MUST BE IN DESCENDING ORDER OF SIZE. THE      S0102010
202*      C              NUMBER OF DROP SIZE CATEGORIES IS DETERMINED BY THE     S0102020
203*      C              NUMBER OF NON-ZERO VALUES INPUT (NO DEFAULTS). IF ISW(2) S0102030
204*      C              EQUALS 0, THIS ARRAY MAY BE THE GEOMETRIC MEAN DIAMETER S0102040
205*      C              IN MICROMETERS AS LONG AS THE ARRAY DRPLWR IS OMITTED OR S0102050
206*      C              SET EQUAL TO THE SAME SET OF VALUES AS DRPUPR.          S0102060
207*      C                                                                      S0102070
208*      C     DRPLWR - ARRAY CONTAINING THE INITIAL LOWER LIMITS TO THE DROP   S0102080
209*      C              DIAMETER IN MICROMETERS OF EACH DROP SIZE CATEGORY. THERES0102090
210*      C              ARE A MAXIMUM OF 20 DROP SIZE CATEGORIES. VALUES INPUT  S0102100
211*      C              TO DRPLWR MUST BE IN DESCENDING ORDER OF SIZE (DEFAULT = S0102110
212*      C              DRPUPR).                                                S0102120
213*      C                                                                      S0102130
214*      C-IF ISW(2) = 1                                                        S0102140
215*      C                                                                      S0102150
216*      C     AIRPRS - BAROMETRIC PRESSURE IN MILLIBARS (DEFAULT=1013.25)      S0102160
217*      C              (ACTUAL, NOT REDUCED TO SEA LEVEL)                      S0102170
218*      C                                                                      S0102180
219*      C     AIRMOL - MOLECULAR WEIGHT OF AIR (DEFAULT=28.9644).              S0102190
220*      C                                                                      S0102200
221*      C     VAPMOL - MOLECULAR WEIGHT OF THE EVAPORATING VAPOR               S0102210
222*      C              (DEFAULT=18.015).                                       S0102220
223*      C                                                                      S0102230
224*      C     RELHMO - RELATIVE HUMIDITY IN PERCENT ABOVE THE CANOPY (NO       S0102240
225*      C              DEFAULT).                                               S0102250
226*      C                                                                      S0102260
227*      C     RELHMU - RELATIVE HUMIDITY IN PERCENT BELOW THE CANOPY (DEFAULT= S0102270
228*      C              RELHMO).                                                S0102280
```

```
C                                                                       S0102290
C     DFUSIV - DIFFUSIVITY OF EVAPORATING VAPOR INTO THE AIR AT THE     S0102300
C              DROP TEMPERATURE (CM**2/SEC). INPUT ONLY IF DROP LIQUID  S0102310
C              IS NOT WATER. IF NOT WATER AND DFUSIV IS OMITTED THE     S0102320
C              PROGRAM DEFAULTS DFUSIV, ASSUMING SIMILAR TO WATER, VIA -S0102330
C                                                                       S0102340
C              DFUSIV=0.211*(((DRPTMP+273.16)/273.16)**1.94)*(1013.25/  S0102350
C                     AIRPRS)                                           S0102360
C                                                                       S0102370
C              WHERE :  DRPTMP = CALCULATED DROP TEMPERATURE.           S0102380
C                                                                       S0102390
C     HETLAT - LATENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE      S0102400
C              (CAL/MOLE). INPUT ONLY IF LIQUID IS NOT WATER. IF OMITTEDS0102410
C              AND LIQUID IS NOT WATER THE PROGRAM DEFAULTS HETLAT,     S0102420
C              ASSUMING SIMILAR TO WATER, VIA -                         S0102430
C                                                                       S0102440
C              HETLAT=597.3*((273.16/(DRPTMP+273.16))**(0.107+3.67E-4*  S0102450
C                     (DRPTMP+273.16)))*VAPMOL                          S0102460
C                                                                       S0102470
C              WHERE :  DRPTMP = CALCULATED DROP TEMPERATURE.           S0102480
C                                                                       S0102490
C              * NOTE - THE DEFAULT VALUE CALCULATED HERE IS NOT        S0102500
C              *        RECOMMENDED FOR LIQUIDS VERY DIFFERENT FROM     S0102510
C              *        WATER.                                          S0102520
C                                                                       S0102530
C     CONMOL - MOLAL CONCENTRATION OF THE AIR-LIQUID MIXTURE (MOLES/    S0102540
C              CM**3). INPUT ONLY IF DROP LIQUID IS NOT WATER. IF       S0102550
C              OMITTED AND LIQUID IS NOT WATER, THE PROGRAM DEFAULTS    S0102560
C              CONMOL VIA -                                             S0102570
C                                                                       S0102580
C              CONMOL=(AIR DENSITY)/AIRMOL                              S0102590
C                                                                       S0102600
C              WHERE : THE AIR DENSITY IS INPUT OR CALCULATED BY THE    S0102610
C                      PROG.                                            S0102620
C                                                                       S0102630
C     THERMC - THERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT THE DROP   S0102640
C              TEMPERATURE (CAL/(SEC.CM.DEGREES K)). INPUT ONLY IF DROP S0102650
C              LIQUID IS NOT WATER. IF NOT WATER AND THERMC IS OMITTED, S0102660
```

```
267*      C                THE PROGRAM DEFAULTS THERMC, ASSUMING DRY AIR, VIA -      S0102670
268*      C                                                                          S0102680
269*      C                THERMC= A*(1.0-(1.17-1.02*(B/A)))*VAPINF/AIRPRS           S0102690
270*      C                                                                          S0102700
271*      C                WHERE :  A = 5.69E-5+1.7E-7*DRPTMP                        S0102710
272*      C                         B = 3.78E-5+2.0E-7*DRPTMP                        S0102720
273*      C                    DRPTMP = CALCULATED DROP TEMP. (DEG K)                S0102730
274*      C                    VAPINF = VAPOR PRESSURE OF THE VAPOR                  S0102740
275*      C                             AT INFINITY (MB)                             S0102750
276*      C                    AIRPRS = BAROMETRIC PRESSURE (MB)                     S0102760
277*      C                                                                          S0102770
278*      C      VAPINF - VAPOR PRESSURE OF THE EVAPORATING VAPOR AT INFINITY        S0102780
279*      C               (MILLIBARS). INPUT ONLY IF THE DROP LIQUID IS NOT WATER.  S0102790
280*      C               IF NOT WATER AND VAPINF IS OMITTED, THE PROGRAM DEFAULTS  S0102800
281*      C               VAPINF TO -                                               S0102810
282*      C                                                                          S0102820
283*      C            VAPINF = 0.01*A*(575.0466+T*(31.82291+T*1.296028))/           S0102830
284*      C                     (93.51611-T)                                         S0102840
285*      C                                                                          S0102850
286*      C            WHERE : T = AIRTPO ABOVE THE CANOPY AND AIRTPU BELOW          S0102860
287*      C                        THE CANOPY                                        S0102870
288*      C                    A = RELHMO ABOVE THE CANOPY AND RELHMU BELOW          S0102880
289*      C                        THE CANOPY                                        S0102890
290*      C                                                                          S0102900
291*      C      BCONST,CCONST - CONSTANTS USED IN THE EQUATION THAT DESCRIBES       S0102910
292*      C                      THE VAPOR PRESSURE OF THE NON-WATER LIQUID AS A     S0102920
293*      C                      FUNCTION OF TEMPERATURE. THE EQUATION IS -          S0102930
294*      C                                                                          S0102940
295*      C                VAPOR PRESSURE=EXP(BCONST-CCONST/(DRPTMP))                S0102950
296*      C                                                                          S0102960
297*      C                WHERE :  DRPTMP = CALCULATED DROP TEMPERATURE (DEG K)     S0102970
298*      C                                                                          S0102980
299*      C                INPUT ONLY IF LIQUID IS NOT WATER. IF LIQUID IS NOT WATERS0102990
300*      C                AND BCONST AND CCONST ARE OMITTED THE PROGRAM DEFAULTS TOS0103000
301*      C                21.07 AND 5249.9, RESPECTIVELY.                           S0103010
302*      C                                                                          S0103020
303*      C-IF ISW(2) = 2                                                            S0103030
304*      C                                                                          S0103040
```

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C     DAU,DBU,DCU - ARRAYS OF COEFFICIENTS OF THE QUADRATIC EQUATION     S0103050
C                   THAT GIVES THE DROP DIAMETER IN MICROMETERS AS A     S0103060
C                   FUNCTION OF TIME ABOVE THE CANOPY. THERE ARE A       S0103070
C                   MAXIMUM OF 20 VALUES FOR EACH ARRAY. THE ORDER OF    S0103080
C                   VALUES IN EACH ARRAY IS IN DESCENDING ORDER OF       S0103090
C                   DROP SIZE. THERE ARE NO DEFAULT VALUES FOR THESE     S0103100
C                   PARAMETERS. THE NUMBER OF DROP SIZE CATEGORIES       S0103110
C                   IS DETERMINED BY THE NUMBER OF NON-ZERO VALUES OF    S0103120
C                   DAU AND DBU INPUT. THE EQUATION IS -                 S0103130
C                                                                        S0103140
C                         DROP = DAU(J) + DBU(J)*T + DCU(J)*T**2         S0103150
C                   WHERE:                                               S0103160
C                          DROP IS DIAMETER IN MICROMETERS.              S0103170
C                          J IS THE INDEX OVER DROP SIZE CATEGORIES.     S0103180
C                          T IS TIME IN SECONDS FROM RELEASE TIME.       S0103190
C                                                                        S0103200
C     DAL,DBL,DCL - ARRAYS OF COEFFICIENTS OF THE QUADRATIC EQUATION     S0103210
C                   THAT GIVES THE DROP DIAMETER IN MICROMETERS AS A     S0103220
C                   FUNCTION OF TIME BELOW THE CANOPY. THERE ARE A       S0103230
C                   MAXIMUM OF 20 VALUES FOR EACH ARRAY. THE ORDER OF    S0103240
C                   VALUES IN EACH ARRAY IS IN DESCENDING ORDER OF       S0103250
C                   DROP SIZE. (DEFAULT=DAU,DBU,DCU). THE EQUATION IS -  S0103260
C                                                                        S0103270
C                         DROP = DAL(J) + DBL(J)*T + DCL(J)*T**2         S0103280
C                   WHERE:                                               S0103290
C                          DROP IS DIAMETER IN MICROMETERS.              S0103300
C                          J IS THE INDEX OVER DROP SIZE CATEGORIES.     S0103310
C                          T IS TIME IN SECONDS FROM RELEASE TIME.       S0103320
C                                                                        S0103330
C****************- INPUTS DEPENDING ON ISW(3)                           S0103340
C                                                                        S0103350
C-IF ISW(3) >= 1                                                         S0103360
C                                                                        S0103370
C     WSIN14 - WIND SPEED IN BOTTOM QUARTER OF FOREST CANOPY IN METERS/  S0103380
C              SECOND (DEFAULT = WSIN24).                                S0103390
C                                                                        S0103400
C     WSIN24 - WIND SPEED IN SECOND QUARTER OF FOREST CANOPY IN METERS/  S0103410
C              SECOND (DEFAULT = WSIN34).                                S0103420
```

```
C                                                                       S0103430
C     WSIN34 - WIND SPEED IN THIRD QUARTER OF FOREST CANOPY IN METERS/  S0103440
C              SECOND (DEFAULT = WSIN44).                               S0103450
C                                                                       S0103460
C     WSIN44 - WIND SPEED IN TOP QUARTER OF FOREST CANOPY IN METERS/    S0103470
C              SECOND (DEFAULT = WSOCAN).                               S0103480
C                                                                       S0103490
C     HGTCAN - ARRAY OF FOREST CANOPY HEIGHTS FOR UP TO 3 FOREST HEIGHT S0103500
C              (STORY) CLASSES. THE VALUES MUST BE INPUT IN WHOLE METERSS0103510
C              IN DESCENDING ORDER OF HEIGHT (NO DEFAULT). THE NUMBER OFS0103520
C              STORIES IS DETERMINED BY THE NUMBER OF NON-ZERO VALUES   S0103530
C              INPUT.                                                   S0103540
C                                                                       S0103550
C     PRBPEN - ARRAY GIVING THE PROBABILITY OF DROP PENETRATION         S0103560
C              HORIZONTALLY THROUGH A TREE (STEM) FOR EACH FOREST       S0103570
C              HEIGHT (STORY) CLASS. FRACTION FROM 0 TO 1 (NO DEFAULTS).S0103580
C                                                                       S0103590
C     TREDEN - ARRAY GIVING THE TREE DENSITIES IN TREES/ACRE            S0103600
C              (STEMS ACRE) FOR EACH FOREST HEIGHT (STORY) CLASS        S0103610
C              DEFINED BY HGTCAN (NO DEFAULTS).                         S0103620
C                                                                       S0103630
C     COLEFF - ARRAY GIVING THE COLLECTION EFFICIENCES FOR EACH DROP    S0103640
C              SIZE CATEGORY. FRACTION FROM 0 TO 1 (NO DEFAULTS).       S0103650
C                             - OR -                                    S0103660
C              ARRAY GIVING THE DIAMETERS IN CENTIMETERS OF THE         S0103670
C              VEGETATIVE ELEMENTS REPRESENTATIVE OF EACH FOREST HEIGHT S0103680
C              CLASS (DEFAULT=-13). THESE VALUES ARE INPUT AS NEGATIVE  S0103690
C              DIAMETERS. THE PROGRAM WILL THEN CALCULATE THE COLLECTIONSS0103700
C              EFFICIENCY USING SELL'S EQUATION -                       S0103710
C                                                                       S0103720
C                       ( (2.8E-4 * D(J)**2 * U)/S : IF EFF (= 1.0      S0103730
C                  EFF =(                                               S0103740
C                       ( 1.0                      : IF EFF > 1.0       S0103750
C                WHERE:                                                 S0103760
C                      EFF = COLLECTION EFFICIENCY                      S0103770
C                      U = CALCULATED IMPACTION VELOCITY IN M/S         S0103780
C                      D(J) = CALCULATED DROP DIAMETER FOR THE JTH      S0103790
C                             DROP SIZE CATEGORY IN MICROMETERS.        S0103800
```

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C                    S = DIAMETER IN CM OF THE VEGETATIVE ELEMENT      S0103910
C                        ON WHICH THE DROP IMPACTS.                    S0103920
C                                                                      S0103930
C     TREENV - ARRAY GIVING THE TREE ENVELOPE (WIDTH) AT EACH METER OF S0103940
C              TREE HEIGHT FOR EACH FOREST HEIGHT CLASS FROM ONE METER  S0103850
C              ABOVE THE GROUND TO THE TOP OF THE TREE HEIGHT. THE FIRSTS0103960
C              HGTCAN(1) VALUES INPUT ARE FOR FOREST HEIGHT 1, THE      S0103870
C              SECOND HGTCAN(2) VALUES ARE FOR HEIGHT 2 AND THE LAST    S0103980
C              HGTCAN(3) FOR THE THIRD FOREST HEIGHT CLASS. THE ENVELOPES0103990
C              WIDTHS ARE INPUT IN METERS. THE MAXIMUM NUMBER OF VALUES S0103900
C              THAT CAN BE INPUT IS GIVEN BY - HGTCAN(1)+HGTCAN(2)+     S0103910
C              HGTCAN(3)<=100 (NO DEFAULTS).                            S0103920
C              NOTE THAT THE VALUES OF HGTCAN ARE HERE TREATED AS       S0103930
C              INTEGERS.                                                S0103940
C                                                                      S0103950
C***************- INPUTS DEPENDING ON ISW(4)                          S0103960
C                                                                      S0103970
C     NSOURC - TOTAL NUMBER OF LINE SOURCES (AIRCRAFT SPRAY LINES),    S0103980
C              (MAXIMUM=100, DEFAULT=1).                               S0103990
C                                                                      S0104000
C     NXPNTS - NUMBER OF X (EAST-WEST) RECEPTOR COORDINATES IN THE     S0104010
C              RECTANGULAR RECEPTOR GRID SYSTEM. (NXPNTS+NYPNTS+       S0104020
C              2*NXYPNT<=100 AND NXPNTS*NYPNTS+NXYPNT<=737) (NO DEFAULT)S0104030
C                                                                      S0104040
C     NYPNTS - NUMBER OF Y (NORTH-SOUTH) RECEPTOR COORDINATES IN THE   S0104050
C              RECTANGULAR RECEPTOR GRID SYSTEM  (NXPNTS+NYPNTS+       S0104060
C              2*NXYPNT<=100 AND NXPNTS*NYPNTS+NXYPNT<=737) (NO DEFAULT)S0104070
C                                                                      S0104080
C     NXYPNT - NUMBER OF DISCRETE (ARBITRARILY PLACED) RECTANGULAR     S0104090
C              RECEPTOR COORDINATES (NXPNTS+NYPNTS+2*NXYPNT<=100 AND   S0104100
C              NXPNTS*NYPNTS+NXYPNT<=737) (NO DEFAULT).                S0104110
C                                                                      S0104120
C     Q - EMISSION OF SPRAY MATERIAL IN GRAMS/METER OR GALLONS/ACRE    S0104130
C         DEPENDING ON THE INPUT PARAMETER SWATH.                      S0104140
C         IF THE PARAMETER SWATH IS GREATER THAN ZERO, THE PROGRAM     S0104150
C         ASSUMES Q IS IN GALLONS/ACRE AND THE AREA SPRAYED IS SPRAYED S0104160
C         IN LINES OF AN EQUAL DISTANCE (SWATH) APART. IF THE SPRAY    S0104170
C         LINES ARE NOT UNIFORM OR THE AREA IS NOT REGULAR INPUT Q IN  S0104180
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C       GRAMS/METER AND SET SWATH TO 0.0 OR OMIT SWATH FROM THE INPUTSS0104190
C       (DEFAULT=1.0). THE EQUATION USED TO CONVERT GALLONS/ACRE TO   S0104200
C       GRAMS/METER BY THE PROGRAM IS -                               S0104210
C                                                                     S0104220
C        Q(G/M) = 9.352938E-1(ACRE.CM**3/GAL.M**2)*DENLIQ(G/CM**3)*   S0104230
C                 SWATH(M)*Q(GAL/ACRE)                                S0104240
C                                                                     S0104250
C       WHERE :   DENLIQ = INPUT LIQUID DENSITY.                      S0104260
C                 SWATH = INPUT SWATH WIDTH.                          S0104270
C                 Q = INPUT EMISSION STRENGTH.                        S0104280
C                                                                     S0104290
C     SWATH - DISTANCE BETWEEN SPRAY LINES IN METERS WHEN Q IS INPUT IN S0104300
C             UNITS OF GALLONS/ACRE. IF Q IS INPUT IN GRAMS/METER     S0104310
C             OMIT SWATH OR SET SWATH TO 0.0 (DEFAULT=0.0).           S0104320
C                                                                     S0104330
C     Z - HEIGHT ABOVE GROUND OF DOSAGE, CONCENTRATION AND DEPOSITION S0104340
C         CALCULATIONS IN METERS. NOTE THAT DOSAGE AND CONCENTRATION  S0104350
C         CAN ONLY BE CALCULATED AT Z >= HGTCAN(1) (DEFAULT=0.0).     S0104360
C                                                                     S0104370
C     SIGAP - STANDARD DEVIATION OF THE WIND DIRECTION ANGLE (RADIANS ORS0104380
C             DEGREES: IF < 1, RADIANS ASSUMED: IF >= 1, DEGREES      S0104390
C             ASSUMED) (NO DEFAULT).                                  S0104400
C                                                                     S0104410
C     SIGEP - STANDARD DEVIATION OF THE WIND ELEVATION ANGLE (RADIANS ORS0104420
C             DEGREES: IF < 1, RADIANS ASSUMED: IF >= 1, DEGREES      S0104430
C             ASSUMED) (NO DEFAULT).                                  S0104440
C                                                                     S0104450
C     TAU - TIME TO SPRAY CLOUD STABILIZATION IN SECONDS (DEFAULT=2.5). S0104460
C                                                                     S0104470
C     TAUO - MEASUREMENT TIME FOR SIGAP IN SECONDS (DEFAULT=600).     S0104480
C                                                                     S0104490
C     SIGXYZ - STANDARD DEVIATION OF THE SOURCE MATERIAL DISTRIBUTION S0104500
C              ALONG THE SPRAY LINE IN METERS (DEFAULT=WNGSPN/4.3).   S0104510
C                                                                     S0104520
C     DECAY - COEFFICIENT OF TIME DEPENDENT EXPONENTIAL DECAY FOR THE S0104530
C             REMOVAL OF MATERIAL DUE TO CHEMICAL OR PHYSICAL PROCESSES.S0104540
C             DECAY IS IN UNITS OF PER SECOND (DEFAULT = 0.0). THE    S0104550
C             FRACTION OF MATERIAL LEFT AFTER TIME T IS GIVEN BY -    S0104560
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```
457*      C                    FRACTION = EXP(-DECAY*T)                                  S0104570
458*      C              SO IF THE HALF LIFE OF THE MATERIAL IS 3600 SECONDS, THEN       S0104580
459*      C              DECAY = 1.92541E-4.                                             S0104590
460*      C                                                                              S0104600
461*      C       XLRZ - LATERAL AND VERTICAL REFERENCE DISTANCE IN METERS. THIS         S0104610
462*      C              PARAMETER IS NORMALLY CALCULATED BY THE PROGRAM. HOWEVER        S0104620
463*      C              IF XLRZ IS INPUT GREATER THAN OR EQUAL TO ZERO, THE INPUT       S0104630
464*      C              VALUE IS USED.                                                  S0104640
465*      C                                                                              S0104650
466*      C       DELU - WIND-SPEED SHEAR ABOVE THE CANOPY IN METERS PER SECOND          S0104660
467*      C              (DEFAULT=0.0).                                                  S0104670
468*      C                                                                              S0104680
469*      C       HM - MIXING LAYER HEIGHT ABOVE GROUND IN METERS (NO DEFAULT).          S0104690
470*      C                                                                              S0104700
471*      C       THETA - WIND DIRECTION IN DEGREES. THIS IS THE DIRECTION FROM          S0104710
472*      C              WHICH THE WIND IS BLOWING, WHERE 0 DEGREES IS NORTH AND         S0104720
473*      C              90 DEGREES IS EAST (NO DEFAULT).                                S0104730
474*      C                                                                              S0104740
475*      C       DAREA - AREA ASSIGNMENT FOR DISCRETE RECEPTOR POINTS FOR THE AREA      S0104750
476*      C              COVERAGE OF DOSAGE, CONCENTRATION AND/OR DEPOSITION IN          S0104760
477*      C              SQUARE METERS (DEFAULT=10000 SQUARE METERS).                    S0104770
478*      C                                                                              S0104780
479*      C       BETA1 - RATIO OF LAGRANGIAN TO EULERIAN TIME-SCALES USED IN THE        S0104790
480*      C              CORRECTION FACTOR ON SIGEP AND SIGAP FOR CROSSING-              S0104800
481*      C              TRAJECTORY EFFECTS OF HEAVY DROPS (DEFAULT=0.0 OR               S0104810
482*      C              NO CORRECTION) (SUGGESTED VALUE FOR BETA1, IF USED,             S0104820
483*      C              IS 1.0). THIS VALUE IS AUTOMATICALLY SET TO 0.0 IF              S0104830
484*      C              EVAPORATION IS BEING USED (ISW(2)>=1).                          S0104840
485*      C              IF BETA1 = 0.0 OR VS/(SIGEP+WSOCAN) <= .2386 THE                S0104850
486*      C                           CORRECTION IS NOT APPLIED TO SIGAP AND SIGEP.      S0104860
487*      C              IF BETA1 > 0.0 AND VS/(SIGEP+WSOCAN) > .2386 THE                S0104870
488*      C                           CORRECTION FACTOR IS APPLIED USING THE             S0104880
489*      C                           EQUATIONS -                                        S0104890
490*      C                                                                              S0104900
491*      C              SIGEPR = SIGEP/(1.0+(BETA1*VS/(WSOCAN*SIGEP))**2)**.25          S0104910
492*      C              SIGAPR = SIGAP/(1.0+4.0*(BETA1*VS/(WSOCAN*SIGEP))**2)**.25      S0104920
493*      C            WHERE :                                                           S0104930
494*      C                 SIGEP = INPUT VALUE                                          S0104940
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C                 SIGAP = INPUT VALUE                                          S0104950
C                    VS = CALCULATED DROP SETTLING VELOCITY                    S0104960
C                 WSOCAN = INPUT WIND SPEED                                    S0104970
C                                                                              S0104980
C     X - ARRAY OF NXPNTS X COORDINATES DEFINING THE (WEST TO EAST)            S0104990
C         AXIS OF THE RECTANGULAR COORDINATE SYSTEM IN METERS.                 S0105000
C         INPUT IN ASCENDING ORDER OF MAGNITUDE (NEG. TO POS.).                S0105010
C         FOLLOW THE LAST X AXIS POINT BY NXYPNT DISCRETE (ARBITRARILY         S0105020
C         PLACED RECEPTOR COORDINATES IN METERS (NO DEFAULTS).                 S0105030
C                                                                              S0105040
C     Y - ARRAY OF NYPNTS Y COORDINATES DEFINING THE (SOUTH TO NORTH)          S0105050
C         AXIS OF THE RECTANGULAR COORDINATE SYSTEM IN METERS.                 S0105060
C         INPUT IN ASCENDING ORDER OF MAGNITUDE (NEG. TO POS.). FOLLOW         S0105070
C         THE LAST Y AXIS COORDINATE WITH NXYPNT DISCRETE (ARBITRARILY         S0105080
C         PLACED) Y RECEPTOR COODINATES IN METERS (NO DEFAULTS).               S0105090
C                                                                              S0105100
C     DX - ARRAY OF START AND END X (EAST-WEST) COORDINATES OF THE LINE        S0105110
C          SOURCES IN METERS. INPUT THE START AND END POINTS OF THE FIRST      S0105120
C          SOURCE, FOLLOWED BY THE START AND END POINTS OF THE SECOND,         S0105130
C          ETC. THERE ARE 2*NSOURC VALUES READ (NO DEFAULTS).                  S0105140
C                                                                              S0105150
C     DY - ARRAY OF START AND END Y (NORTH-SOUTH) COORDINATES OF THE           S0105160
C          LINE SOURCES IN METERS. INPUT THE START AND END POINTS OF THE       S0105170
C          FIRST SOURCE, FOLLOWED BY THE START AND END POINTS OF THE           S0105180
C          SECOND, ETC. THERE ARE 2*NSOURC POINTS READ (NO DEFAULTS).          S0105190
C                                                                              S0105200
C     PCTMAT - ARRAY OF FRACTION OF TOTAL SPRAY MATERIAL IN EACH DROP          S0105210
C              SIZE CATEGORY (FRACTION, 0 TO 1). (MAXIMUM OF 20 VALUES).       S0105220
C              (NO DEFAULTS)                                                   S0105230
C                                                                              S0105240
C     GAMA, GAMB, GAMC - ARRAYS OF COEFFICIENTS OF THE QUADRATIC               S0105250
C           EQUATION THAT GIVES THE FRACTION OF MATERIAL REFLECTED             S0105260
C           AT THE SURFACE AS A FUNCTION OF THE DROP SETTLING VELOCITY.        S0105270
C                                                                              S0105280
C           FRACTION = GAMA(J)+GAMB(J)*VS+GAMC(J)*VS**2                        S0105290
C           WHERE: VS IS THE DROP SETTLING VELOCITY IN METERS/SEC.             S0105300
C                  (1     ,IF VS )= VSGAM(1)                                   S0105310
C              J = (2     ,IF VS )= VSGAM(2) & VS < VSGAM(1)                   S0105320
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533*     C                    (3      ,IF VS <  VSGAM(2)                                  S0105330
534*     C                                                                                S0105340
535*     C          THREE COEFFICIENTS OF GAMA, GAMB AND GAMC EACH MUST BE INPUTS0105350
536*     C          THE FIRST VALUE OF EACH ARRAY IS FOR SETTLING VELOCITIES    S0105360
537*     C          GREATER THAN OR EQUAL TO VSGAM(1). THE SECOND VALUE OF EACH S0105370
538*     C          ARRAY IS FOR SETTLING VELOCITIES LESS THAN VSGAM(1) AND     S0105380
539*     C          GREATER THAN OR EQUAL TO VSGAM(2). THE THIRD VALUE OF EACH  S0105390
540*     C          ARRAY IS FOR SETTLING VELOCITIES LESS THAN VSGAM(2). THE    S0105400
541*     C          DEFAULT VALUES FOR THE THREE ARRAYS ARE -                   S0105410
542*     C          GAMA(1)=0.75, GAMA(2)=0.83465302, GAMA(3)=.91639996         S0105420
543*     C          GAMB(1)=-2.5, GAMB(2)=-6.9031391, GAMB(3)=-22.357124        S0105430
544*     C          GAMC(1)=0.00, GAMC(2)=57.4092560, GAMC(3)=821.426510        S0105440
545*     C                                                                      S0105450
546*     C     VSGAM - ARRAY OF TWO SETTLING VELOCITIES THAT SPECIFY THE        S0105460
547*     C          SETTLING VELOCITIES THAT BREAK THE CURVE OF SURFACE         S0105470
548*     C          REFLECTION COEFFICIENTS GIVEN BY GAMA, GAMB AND GAMC INTO   S0105480
549*     C          THREE PARTS (METERS/SEC). VS VALUES GREATER THAN OR EQUAL TOS0105490
550*     C          VSGAM(1) USE GAMA(1), GAMB(1) AND GAMC(1) TO CALCULATE THE  S0105500
551*     C          SURFACE REFLECTION COEFFICIENT. VS VALUES LESS THAN VSGAM(1)S0105510
552*     C          BUT GREATER THAN OR EQUAL TO VSGAM(2) USE GAMA(2), GAMB(2)  S0105520
553*     C          AND GAMC(2) TO CALCULATE THE SURFACE REFLECTION COEFFICIENT.S0105530
554*     C          VS VALUES LESS THAN VSGAM(2) USE GAMA(3), GAMB(3) AND       S0105540
555*     C          GAMC(3) TO CALCULATE THE SURFACE REFLECTION COEFFICIENT. THES0105550
556*     C          DEFAULT VALUES FOR VSGAM ARE - VSGAM(1)= .04, VSGAM(2)=.012.S0105560
557*     C                                                                      S0105570
558*     C     DOSLV - ARRAY OF DOSAGE LEVELS IN OUTPUT DOSAGE UNITS FOR THE    S0105580
559*     C            CALCULATION OF AREA OF COVERAGE OF DOSAGE (MAXIMUM OF     S0105590
560*     C            10 VALUES) (NO DEFAULTS).                                 S0105600
561*     C                                                                      S0105610
562*     C     CONLV - ARRAY OF CONCENTRATION LEVELS IN OUTPUT CONCENTRATION    S0105620
563*     C            UNITS FOR THE CALCULATION OF AREA OF COVERAGE OF           S0105630
564*     C            CONCENTRATION (MAXIMUM OF 10 VALUES) (NO DEFAULTS).       S0105640
565*     C                                                                      S0105650
566*     C     DEPLV - ARRAY OF DEPOSITION LEVELS IN OUTPUT DEPOSITION UNITS    S0105660
567*     C            FOR THE CALCULATION OF AREA OF COVERAGE OF DEPOSITION     S0105670
568*     C            (MAXIMUM OF 10 VALUES) (NO DEFAULTS).                     S0105680
569*     C                                                                      S0105690
570*     C                                                                      S0105700
```

```
C***************- FSCBG INPUT DATA MODE -*****************************
C
C***************- BATCH MODE VIA NAMELIST QLST1
C
C     THE DATA DECK MUST BEGIN WITH $QLST1 TYPED IN COLUMNS 2 THROUGH
C     7, FOLLOWED BY AT LEAST 1 BLANK. SOME COMPUTERS USE THE * SYMBOL
C     RATHER THAN $. THE DATA DECK MUST END WITH $END TYPED IN ANY OF
C     COLUMNS 2 THROUGH 77 AND MUST BE PRECEEDED WITH AT LEAST ONE
C     BLANK. DATA VALUES ARE ENTERED BY TYPING THE NAME OF THE PARAMETERS
C     FOLLOWED BY = FOLLOWED BY VALUE (DECIMAL OR INTEGER) FOLLOWED BY
C     A COMMA WITH NO INTERVENING BLANKS. ARRAY ITEM VALUES ARE TYPED
C     ACROSS THE INPUT IMAGE WITH A SEPARATING COMMA BETWEEN VALUES.
C     MULTIPLE VALUES THAT ARE THE SAME CAN BE TYPED K*####, WHERE K
C     DENOTES THE NUMBER OF OCCURRENCES OF THE VALUE. HOLLERITH
C     PARAMETERS SUCH AS TITLE ARE INPUT BY NAME (TITLE) FOLLOWED BY
C     = FOLLOWED BY THE NUMBER OF HOLLERITH CHARACTERS FOLLOWED BY AN
C     H FOLLOWED BY THE CHARACTER STRING FOLLOWED BY A COMMA. VALUES
C     OMITTED FROM THE INPUT DECK ASSUME THEIR DEFAULT VALUES.
C
C
C
C
C***************** END OF INPUT DATA ***************************************
C
C
C
C
      CALL CBGS1
      STOP
      END
```

```
      BLOCK DATA                                                        S0200010
      COMMON /COM1/ IDUMA(75)                                           S0200020
      COMMON /COM2/ ADUMJ(38),BDUMJ(810),CDUMJ(620)                     S0200030
      COMMON /COM3/ ADUMK(371),BDUMK(525),KDUMA(2),CDUMK(320),DDUMK(1080S0200040
     *)                                                                 S0200050
      DATA IDUMA/5,6,6*0,40*1H ,20*0,7*0/                               S0200060
      DATA ADUMJ/0.5,-1.0E15,3*0.0,1.0,20*0.0,7*0.0,2.5,600.0,0.0       S0200070
     *,-1.0E15,0.0/                                                     S0200080
      DATA BDUMJ/810*0.0/                                               S0200090
      DATA CDUMJ/220*1.0,360*0.0,-1.0E15,4*0.0,10000.0,0.0,.75,         S0200100
     *.83465302,.91639996,-2.5,-6.9031391,-22.357124,0.0,57.409256,     S0200110
     *821.426510,.04,.012,2*0.0,20*1.0/                                 S0200120
      DATA ADUMK/4*-1.E15,1013.25,-1.0E15,21.07,5249.9,2*0.0,18.015,    S0200130
     *-1.E15,-1.E15,3*-1.0E15,28.9644,1.0,                              S0200140
     *49*0.0,3*-13.,17*0.0,103*0.0,120*-1.0E15,17*0.0,1.0,2.0,4.0,6.0,  S0200150
     *10.0,20.0,40.0,60.0,100.0,200.0,400.0,600.0,1.0E3,2.0E3,4.0E3,    S0200160
     *6.0E3,1.0E4,2.0E4,4.0E4,6.0E4,1.0E5,2.0E5,24.0,64.0,140.0,230.0,  S0200170
     *420.0,1160.0,2880.0,5400.0,1.2E4,3.2E4,9.76E4,1.94E5,4.6E5,1.64E6,S0200180
     *6.4E6,1.44E7,4.1E7,1.76E8,7.33E8,1.65E9,4.4E9,1.64E10/            S0200190
      DATA BDUMK/525*0.0/                                               S0200200
      DATA KDUMA/2*0/                                                   S0200210
      DATA CDUMK/320*0.0/                                               S0200220
      END                                                               S0200230
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 1*            SUBROUTINE CBGS1                                                  S0300010
 2*            COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0300020
 3*           *ISW(20),I,J,K,L,M,N,NYS                                           S0300030
 4*            COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0300040
 5*           *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,  S0300050
 6*           *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0300060
 7*           *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0300070
 8*           *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0300080
 9*           *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0300090
10*           *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0300100
11*            COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0300110
12*           *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0300120
13*           *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0300130
14*           *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0300140
15*           *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0300150
16*           *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0300160
17*           *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,   S0300170
18*           *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0300180
19*           *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0300190
20*           *TMLSO(20),RDST(20),XLOCS(20),                                     S0300200
21*           *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0300210
22*           *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0300220
23*            INTEGER TITLE                                                     S0300230
24*            DIMENSION IFMT(3)                                                 S0300240
25*            DIMENSION IDO(1)                                                  S0300250
26*            EQUIVALENCE (IDO(1),HIO(1))                                       S0300260
27*            DATA RAD/.01745329/                                               S0300270
28*            DATA IFMT/2H(3,2HI2,1H)/                                          S0300280
29*            NAMELIST /QLST1/ ISW,WAKVEL,ARCRWT,SWATH,WNGSPN,ARCRSP,WSOCAN,    S0300290
30*           *AIRTPO,AIRTPU,AIRPRS,AIRMOL,DENLIQ,VAPMOL,RELHMO,RELHMU,DFUSIV,   S0300300
31*           *HETLAT,CONMOL,THERMC,VAPINF,BCONST,CCONST,HGTCFT,DRPUPR,DRPLWR,   S0300310
32*           *HGTCAN,WSIN14,WSIN24,WSIN34,WSIN44,IFWATR,Z,PRBPEN,COLEFF,        S0300320
33*           *TREDEN,TREENV,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,   S0300330
34*           *SIGXYZ,XLRZ,HM,Q,DX,DY,X,Y,PCTMAT,TITLE,THETA,DEPLV,              S0300340
35*           *DOSLV,CONLV,DAREA,BETA1,AIRDEN,DAU,DBU,DCU,DECAY,VSGAM,GAMA,      S0300350
36*           *GAMB,GAMC,DELU                                                    S0300360
37*     C                                                                        S0300370
38*     C                                                                        S0300380
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C                                                                       S0300390
C                                                                       S0300400
      IF (INPFIL .LE. 0) INPFIL = 5                                     S0300410
      IF (IOTFIL .LE. 0) IOTFIL = 6                                     S0300420
C                                                                       S0300430
C                                                                       S0300440
C                                                                       S0300450
C***********************************************************************S0300460
C     READ INPUT DATA                                                   S0300470
C                                                                       S0300480
C     *** BATCH MODE INPUT VIA NAMELIST QLST1 ***                       S0300490
      READ (INPFIL,QLST1)                                               S0300500
C                                                                       S0300510
C                                                                       S0300520
C                                                                       S0300530
C                                                                       S0300540
C     DEFAULT INPUT PARAMETERS                                          S0300550
      IF (IFWATR .LE. 0) IFWATR = 1                                     S0300560
      IF (AIRTPU .LE. -1.0E15) AIRTPU = AIRTPO                          S0300570
      IF (AIRPRS .LE. 0.0) AIRPRS = 1013.25                             S0300580
      IF (AIRMOL .LE. 0.0) AIRMOL = 28.9644                             S0300590
      IF (DENLIQ .LE. 0.0) DENLIQ = 1.0                                 S0300600
      IF (VAPMOL .LE. 0.0) VAPMOL = 18.015                              S0300610
      IF (RELHMU .LE. 0.0) RELHMU = RELHMO                              S0300620
      IF (WSIN44 .LE. 0.0) WSIN44 = WSOCAN                              S0300630
      IF (WSIN34 .LE. 0.0) WSIN34 = WSIN44                              S0300640
      IF (WSIN24 .LE. 0.0) WSIN24 = WSIN34                              S0300650
      IF (WSIN14 .LE. 0.0) WSIN14 = WSIN24                              S0300660
      IF (IFWATR .LE. 1) GO TO 10                                       S0300670
      IF (BCONST .LE. 0.0) BCONST = 21.07                               S0300680
      IF (CCONST .LE. 0.0) CCONST = 5249.9                              S0300690
   10 IF (TAU .LE. 0.0) TAU = 2.5                                       S0300700
      IF (TAUO .LE. 0.0) TAUO = 600.0                                   S0300710
      IF (DELU .LT. 0.0) DELU = 0.0                                     S0300720
C     CANNOT USE BETA1 WITH EVAPORATION                                 S0300730
      IF (ISW(2) .GT. 0) BETA1 = 0.0                                    S0300740
      IF (SIGXYZ .LE. 0.0) SIGXYZ = WNGSPN/4.3                          S0300750
      NVS = 0                                                           S0300760
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77*            IF (ISW(2) .EQ. 2) GO TO 30                                    S0300770
78*            DO 20 I=1,20                                                   S0300780
79*            IF (DRPUPR(I) .GT. 0.0) NVS = NVS+1                            S0300790
80*            IF (DRPLWR(I) .LE. 0.0) DRPLWR(I) = DRPUPR(I)                  S0300800
81*         20 CONTINUE                                                       S0300810
82*            GO TO 60                                                       S0300820
83*         30 DO 40 I=1,20                                                   S0300830
84*            IF (DAU(I) .GT. -1.0E15) NVS = NVS+1                           S0300840
85*         40 CONTINUE                                                       S0300850
86*            IF (ISW(3) .EQ. 0) GO TO 60                                    S0300860
87*            DO 50 I=1,20                                                   S0300870
88*            IF (DAL(I) .LE. -1.0E15) DAL(I) = DAU(I)                       S0300880
89*            IF (DBL(I) .LE. -1.0E15) DBL(I) = DBU(I)                       S0300890
90*            IF (DCL(I) .LE. -1.0E15) DCL(I) = DCU(I)                       S0300900
91*         50 CONTINUE                                                       S0300910
92*         60 CONTINUE                                                       S0300920
93*            IF (ISW(9) .NE. 0) GO TO 100                                   S0300930
94*            T1 = DENLIQ*4.18879                                            S0300940
95*            DO 90 I=1,NVS                                                  S0300950
96*            IF (ISW(2) .EQ. 2) GO TO 70                                    S0300960
97*            RD(1) = DRPUPR(I)                                              S0300970
98*            RD(2) = DRPLWR(I)                                              S0300980
99*            GO TO 80                                                       S0300990
100*        70 RD(1) = DAU(I)                                                 S0301000
101*           RD(2) = DAL(I)                                                 S0301010
102*        80 RD(1) = RD(1)*5.0E-5                                           S0301020
103*           RD(2) = RD(2)*5.0E-5                                           S0301030
104*           T2 = AVGRD(RD(1),RD(2))                                        S0301040
105*        90 CONV(I) = 1.0/(T1*T2*T2*T2)                                    S0301050
106*       100 CONTINUE                                                       S0301060
107*           IF (NSOURC .LE. 0) NSOURC = 1                                  S0301070
108*           IF (SIGEP .GE. 1.0) SIGEP = SIGEP*RAD                          S0301080
109*           IF (SIGAP .GE. 1.0) SIGAP = SIGAP*RAD                          S0301090
110*           IF (DAREA .LE. 0.0) DAREA = 10000.0                            S0301100
111*     C                                                                    S0301110
112*     C     GET DATE - PLACE MONTH IN IDATE(1), DAY IN IDATE(2) AND YEAR IN S0301120
113*     C                IDATE(3) - ALL INTEGER                              S0301130
114*     C                                                                    S0301140
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115*            CALL ADATE(IDO(1),IDO(3))                                S0301150
116*            DECODE (IFMT,IDO(1)) IDATE(1),IDATE(2),IDATE(3)          S0301190
117*      C                                                              S0301200
118*      C                                                              S0301210
119*      C                                                              S0301220
120*      C                                                              S0301230
121*            LINE = 0                                                 S0301240
122*            IPAGE = 0                                                S0301250
123*            ITABLE = 0                                               S0301260
124*      C                                                              S0301270
125*      C                                                              S0301280
126*      C                                                              S0301290
127*      C                                                              S0301300
128*        110 CONTINUE                                                 S0301310
129*            CALL CBGS2                                               S0301320
130*            RETURN                                                   S0301330
131*            END                                                      S0301340
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      SUBROUTINE CBGS2                                                  S0400010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0400020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0400030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0400040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0400050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0400060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0400070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0400080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETAI      S0400090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0400100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0400110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0400120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0400130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0400140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0400150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0400160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0400170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0400180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0400190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0400200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0400210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0400220
      INTEGER TITLE                                                     S0400230
      CALL IOPUT(1,1,0)                                                 S0400240
      WRITE (IOTFIL,9001)                                               S0400250
      WRITE (IOTFIL,9002) ISW,IFWATR,WNGSPN,WSOCAN,HGTCFT,DENLIQ,AIRTPO,S0400260
     *AIRTPU,AIRDEN                                                     S0400270
      IF (AIRDEN .GT. 0.0) GO TO 10                                     S0400280
      WRITE (IOTFIL,9003) AIRMOL,AIRPRS,VAPINF                          S0400290
   10 IF (VAPINF .GE. 0.0) GO TO 20                                     S0400300
      WRITE (IOTFIL,9004) RELHMO,RELHMU                                 S0400310
   20 WRITE (IOTFIL,9005)                                               S0400320
      IF (ISW(1) .EQ. 0) GO TO 30                                       S0400330
      WRITE (IOTFIL,9006) ARCRWT,ARCRSP                                 S0400340
      GO TO 40                                                          S0400350
   30 WRITE (IOTFIL,9007) WAKVEL                                        S0400360
   40 WRITE (IOTFIL,9008)                                               S0400370
      IF (ISW(2) .EQ. 2) GO TO 50                                       S0400380
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      WRITE (IOTFIL,9009) (DRPUPR(I),I=1,NVS)                          S0400390
      WRITE (IOTFIL,9010) (DRPLWR(I),I=1,NVS)                          S0400400
      IF (ISW(2) .EQ. 0) GO TO 60                                      S0400410
      WRITE (IOTFIL,9011) AIRPRS,AIRMOL,VAPMOL,RELHMO,RELHMU           S0400420
      IF (IFWATR .LE. 1) GO TO 60                                      S0400430
      WRITE (IOTFIL,9012) DFUSIV,HETLAT,CONMOL,THERMC,VAPINF,BCONST,   S0400440
     *CCONST                                                           S0400450
      GO TO 60                                                         S0400460
   50 WRITE (IOTFIL,9013) (DAU(I),I=1,NVS)                             S0400470
      WRITE (IOTFIL,9014) (DBU(I),I=1,NVS)                             S0400480
      WRITE (IOTFIL,9015) (DCU(I),I=1,NVS)                             S0400490
      IF (ISW(3) .EQ. 0) GO TO 60                                      S0400500
      WRITE (IOTFIL,9016) (DAL(I),I=1,NVS)                             S0400510
      WRITE (IOTFIL,9017) (DBL(I),I=1,NVS)                             S0400520
      WRITE (IOTFIL,9018) (DCL(I),I=1,NVS)                             S0400530
   60 IF (ISW(3) .EQ. 0) GO TO 100                                     S0400540
      LINE = 57                                                        S0400550
      CALL IOPUT(0,1,0)                                                S0400560
      WRITE (IOTFIL,9019)                                              S0400570
      WRITE (IOTFIL,9020) WSIN14,WSIN24,WSIN34,WSIN44,HGTCAN,PRBPEN,   S0400580
     *TREDEN                                                           S0400590
      IF (COLEFF(1) .LT. 0.0) GO TO 70                                 S0400600
      WRITE (IOTFIL,9021) (COLEFF(I),I=1,NVS)                          S0400610
      GO TO 80                                                         S0400620
   70 XDO(1) = ABS(COLEFF(1))                                          S0400630
      XDO(2) = ABS(COLEFF(2))                                          S0400640
      XDO(3) = ABS(COLEFF(3))                                          S0400650
      WRITE (IOTFIL,9022) (XDO(I),I=1,3)                               S0400660
   80 K = 1                                                            S0400670
      IF (HGTCAN(2) .GT. 0) K = 2                                      S0400680
      IF (HGTCAN(3) .GT. 0) K = 3                                      S0400690
      L = 0                                                            S0400700
      DO 90 N=1,K                                                      S0400710
      J = HGTCAN(N)                                                    S0400720
      WRITE (IOTFIL,9023) N,(TREENV(I+L),I=1,J)                        S0400730
   90 L = L+J                                                          S0400740
  100 IF (ISW(4) .EQ. 0) GO TO 140                                     S0400750
      LINE = 57                                                        S0400760
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      CALL IOPUT(0,1,0)                                                 S0400770
      WRITE (IOTFIL,9024)                                               S0400780
      WRITE (IOTFIL,9025) NSOURC,NXPNTS,NYPNTS,NXYPNT                   S0400790
      IF (SWATH .LE. 0.0) GO TO 110                                     S0400800
      WRITE (IOTFIL,9026) Q,SWATH                                       S0400810
      GO TO 120                                                         S0400820
  110 WRITE (IOTFIL,9027) Q                                             S0400830
  120 WRITE (IOTFIL,9028) Z,SIGAP,SIGEP,TAU,TAUD,SIGXYZ,DECAY           S0400840
      WRITE (IOTFIL,9029) XLRZ,HM,THETA,DAREA,BETA1,DELU                S0400850
      IF (NXPNTS .GT. 0) WRITE (IOTFIL,9030) (X(I),I=1,NXPNTS)          S0400860
      IF (NYPNTS .GT. 0) WRITE (IOTFIL,9031) (Y(I),I=1,NYPNTS)          S0400870
      IF (NXYPNT .LE. 0) GO TO 130                                      S0400880
      WRITE (IOTFIL,9032) (X(I+NXPNTS),I=1,NXYPNT)                      S0400890
      WRITE (IOTFIL,9033) (Y(I+NYPNTS),I=1,NXYPNT)                      S0400900
  130 J = 2*NSOURC                                                      S0400910
      WRITE (IOTFIL,9034) (DX(I),I=1,J)                                 S0400920
      WRITE (IOTFIL,9035) (DY(I),I=1,J)                                 S0400930
      WRITE (IOTFIL,9036) (PCTMAT(I),I=1,NVS)                           S0400940
      WRITE (IOTFIL,9037) (VSGAM(I),I=1,2)                              S0400950
      WRITE (IOTFIL,9038) GAMA,GAMB,GAMC                                S0400960
      IF (ISW(12) .LE. 0) GO TO 140                                     S0400970
      IF (ISW(6) .GT. 0) WRITE (IOTFIL,9039) (DOSLV(I),I=1,10)          S0400980
      IF (ISW(7) .GT. 0) WRITE (IOTFIL,9040) (CONLV(I),I=1,10)          S0400990
      IF (ISW(8) .GT. 0) WRITE (IOTFIL,9041) (DEPLV(I),I=1,10)          S0401000
  140 CONTINUE                                                          S0401010
  150 CONTINUE                                                          S0401020
      IF (SWATH .GT. 0.0) Q = Q*DENLIQ*SWATH*9.352938E-1                S0401030
  160 CONTINUE                                                          S0401040
      CALL CBGS3                                                        S0401050
      RETURN                                                            S0401060
 9001 FORMAT (10X,33H*** INPUTS USED BY ALL MODELS ***)                 S0401070
 9002 FORMAT (05X,24HPROGRAM OPTIONS, (ISW) =,20I2/                     S0401080
     *05X,62HIS LIQUID WATER OR NON-WATER, 2=NON-WATER, 1=WATER, (IFWATRS0401090
     *) =,I2/05X,38HAIRCRAFT WING SPAN (WNGSPN (METERS)) =,F7.2/        S0401100
     *05X,40HWIND SPEED ABOVE CANOPY (WSOCAN (M/S)) =,F6.3/             S0401110
     *05X,38HHEIGHT OF AIRCRAFT (HGTCFT (METERS)) =,F7.2/               S0401120
     *05X,44HDENSITY OF SPRAY LIQUID (DENLIQ (G/CM**3)) =,F9.4/         S0401130
     *05X,51HAIR TEMPERATURE ABOVE THE CANOPY (AIRTPO (DEG C)) =,F7.3/  S0401140
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115*          *05X,51HAIR TEMPERATURE BELOW THE CANOPY (AIRTPU (DEG C)) =,F7.3/  S0401150
116*          *05X,32HAIR DENSITY (AIRDEN (G/CM**3)) =,F9.4)                     S0401160
117*        9003 FORMAT (05X,34HMOLECULAR WEIGHT OF AIR (AIRMOL) =,F8.4/         S0401170
118*          *05X,35HBAROMETRIC PRESSURE (AIRPRS (MB)) =,F7.2/                  S0401180
119*          *05X,60HVAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) S0401190
120*          *=,F7.4)                                                          S0401200
121*        9004 FORMAT (05X,49HRELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) =,FS0401210
122*          *7.3/05X,49HRELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) =,F7.3)S0401220
123*        9005 FORMAT (1H0,9X,55H*** INPUTS USED BY THE WAKE SETTLING VELOCITY MOS0401230
124*          *DEL ***)                                                         S0401240
125*        9006 FORMAT (5X,31HAIRCRAFT WEIGHT (ARCRWT (KG)) =,F9.3/            S0401250
126*          *05X,38HAIRCRAFT GROUND SPEED (ARCRSP (M/S)) =,F8.3)              S0401260
127*        9007 FORMAT (5X,39HWAKE SETTLING VELOCITY (WAKVEL (M/S)) =,F8.4)    S0401270
128*        9008 FORMAT (1H0,9X,44H*** INPUTS USED BY THE EVAPORATION MODEL ***) S0401280
129*        9009 FORMAT (5X,51HUPPER LIMITS OF DROP DIAMETERS (DRPUPR (MICRO-M)) =/S0401290
130*          *(05X,7(F8.3,1H,)))                                               S0401300
131*        9010 FORMAT (05X,51HLOWER LIMITS OF DROP DIAMETERS (DRPLWR (MICRO-M)) =S0401310
132*          */(05X,7(F8.3,1H,)))                                              S0401320
133*        9011 FORMAT (05X,35HBAROMETRIC PRESSURE (AIRPRS (MB)) =,F7.2/       S0401330
134*          *05X,34HMOLECULAR WEIGHT OF AIR (AIRMOL) =,F8.4/                  S0401340
135*          *05X,48HMOLECULAR WEIGHT OF EVAPORATING VAPOR (VAPMOL) =,F8.4/    S0401350
136*          *05X,49HRELATIVE HUMIDITY ABOVE THE CANOPY (RELHMO (%)) =,F7.3/   S0401360
137*          *05X,49HRELATIVE HUMIDITY BELOW THE CANOPY (RELHMU (%)) =,F7.3)   S0401370
138*        9012 FORMAT (05X,53HDIFFUSIVITY OF EVAPORATING VAPOR (DFUSIV (CM/S**2))S0401380
139*          * =,E12.6/                                                        S0401390
140*          *05X,49HLATENT HEAT OF VAPORIZATION (HETLAT (CAL/MOLE)) =,F12.6/  S0401400
141*          *05X,55HMOLAL CONCENTRATION AIR-LIQ MIX (CONMOL (MOLE/CM**3)) =,E12S0401410
142*          *.6/                                                              S0401420
143*          *05X,57HTHERMAL CONDUCTIVITY OF VAPOR (THERMC (CAL/S.CM.DEG K)) =,ES0401430
144*          *11.5/                                                            S0401440
145*          *05X,60HVAPOR PRESS OF EVAPORATING VAPOR AT INFINITY (VAPINF (MB)) S0401450
146*          *=,F7.4/                                                          S0401460
147*          *05X,54HCONSTS TO CALC VAPOR PRESS OF LIQUID (BCONST,CCONST) =,2F8.S0401470
148*          *2)                                                               S0401480
149*        9013 FORMAT (1H0,4X,60HABOVE CANOPY COEFFICIENTS OF DROP=DAU+DBU*T+DCU*S0401490
150*          *T**2 (DAU) =/(10X,5(E11.5,1H,)))                                 S0401500
151*        9014 FORMAT (05X,60HABOVE CANOPY COEFFICIENTS OF DROP=DAU+DBU*T+DCU*T**S0401510
152*          *2 (DBU) =/(10X,5(E11.5,1H,)))                                    S0401520
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153*      9015 FORMAT (05X,60HABOVE CANOPY COEFFICIENTS OF DROP=DAU+DBU*T+DCU*T**S0401530
154*          *2 (DCU) =/(10X,5(E11.5,1H,)))                                    S0401540
155*      9016 FORMAT (05X,60HBELOW CANOPY COEFFICIENTS OF DROP=DAL+DBL*T+DCL*T**S0401550
156*          *2 (DAL) =/(10X,5(E11.5,1H,)))                                    S0401560
157*      9017 FORMAT (05X,60HBELOW CANOPY COEFFICIENTS OF DROP=DAL+DBL*T+DCL*T**S0401570
158*          *2 (DBL) =/(10X,5(E11.5,1H,)))                                    S0401580
159*      9018 FORMAT (05X,60HBELOW CANOPY COEFFICIENTS OF DROP=DAL+DBL*T+DCL*T**S0401590
160*          *2 (DCL) =/(10X,5(E11.5,1H,)))                                    S0401600
161*      9019 FORMAT (10X,51H*** INPUTS USED BY THE CANOPY PENETRATION MODEL ***S0401610
162*          *)                                                                S0401620
163*      9020 FORMAT (5X,55HWIND SPEED IN BOTTOM QUARTER OF CANOPY (WSIN14 (M/S)S0401630
164*          *) =,F6.3/                                                        S0401640
165*          *05X,55HWIND SPEED IN SECOND QUARTER OF CANOPY (WSIN24 (M/S)) =,F6.S0401650
166*          *3/                                                               S0401660
167*          *05X,54HWIND SPEED IN THIRD QUARTER OF CANOPY (WSIN34 (M/S)) =,F6.3S0401670
168*          */                                                                S0401680
169*          *05X,52HWIND SPEED IN TOP QUARTER OF CANOPY (WSIN44 (M/S)) =,F6.3/ S0401690
170*          *05X,36HHEIGHT OF CANOPY (HGTCAN (METERS)) =,3(F6.2,1H,)/          S0401700
171*          *05X,37HPROBABILITY OF PENETRATION (PRBPEN) =,3(F5.3,1H,)/         S0401710
172*          *05X,36HTREE DENSITY (TREDEN (TREES/ACRE)) =,3(F7.2,1H,))          S0401720
173*      9021 FORMAT (05X,54HCOLLECTION EFFICIENCIES FOR DROP CATEGORIES (COLEFFS0401730
174*          *) =/(05X,10(F5.3,1H,)))                                          S0401740
175*      9022 FORMAT (05X,47HDIAMETER OF VEGETATIVE ELEMENTS (COLEFF (CM)) =,3(FS0401750
176*          *6.2,1H,))                                                        S0401760
177*      9023 FORMAT (05X,47HTREE WIDTH FROM BOTTOM TO TOP FOR FOREST CLASS ,I1,S0401770
178*          *15H (TREENV (M)) =/(05X,9(F6.3,1H,)))                            S0401780
179*      9024 FORMAT (10X,44H*** INPUTS USED BY THE DISPERSION MODELS ***)      S0401790
180*      9025 FORMAT (5X,33HNUMBER OF LINE SOURCES (NSOURC) =,I4/               S0401800
181*          *05X,52HNUMBER OF RECEPTORS IN GRID SYSTEM X AXIS (NXPNTS) =,I4/   S0401810
182*          *05X,52HNUMBER OF RECEPTORS IN GRID SYSTEM Y AXIS (NYPNTS) =,I4/   S0401820
183*          *05X,39HNUMBER OF DISCRETE RECEPTORS (NXYPNT) =,I4)                S0401830
184*      9026 FORMAT (05X,43HEMISSION OF SPRAY MATERIAL (Q (GAL/ACRE)) =,E12.6/ S0401840
185*          *05X,42HDISTANCE BETWEEN SPRAY LINES (SWATH (M)) =,F9.3)           S0401850
186*      9027 FORMAT (05X,42HEMISSION OF SPRAY MATERIAL (Q (GRAMS/M)) =,E12.6)  S0401860
187*      9028 FORMAT (05X,49HHEIGHT OF DISPERSION MODELS CALCULATION (Z (M)) =,FS0401870
188*          *7.2/                                                             S0401880
189*          *05X,53HSTANDARD DEV. OF WIND DIRECTION ANGLE (SIGAP (RAD)) =,F7.5/S0401890
190*          *05X,53HSTANDARD DEV. OF WIND ELEVATION ANGLE (SIGEP (RAD)) =,F7.5/S0401900
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191*          *05X,47HTIME TO SPRAY CLOUD STABILIZATION (TAU (SEC)) =,F8.3/      S0401910
192*          *05X,41HMEASUREMENT TIME FOR SIGAP (TAUO (SEC)) =,F8.3/            S0401920
193*          *05X,61HSTAND. DEV. OF SPRAY MATERIAL ALONG SPRAY LINE (SIGXYZ (M))S0401930
194*          *)=,F8.3/                                                          S0401940
195*          *05X,34HDECAY COEFFICIENT (DECAY (/SEC)) =,E12.6)                  S0401950
196*        9029 FORMAT (05X,43HLAT., VERT. REFERENCE DISTANCE (XLRZ (M)) =,F9.3/ S0401960
197*          *05X,38HSURFACE MIXING LAYER HEIGHT (HM (M)) =,F9.3/               S0401970
198*          *05X,37HWIND DIRECTION (FROM) (THETA (DEG)) =,F7.2/                S0401980
199*          *05X,55HAREA ASSIGNMENT FOR DISCRETE RECEPTORS (DAREA (M**2)) =,F12S0401990
200*          *.2/05X,53HRATIO OF LAGRANGIAN TO EULERIAN TIME SCALES (BETA1) =,F5S0402000
201*          *.2/05X,31HWIND-SPEED SHEAR (DELU (M/S)) =,F7.4)                   S0402010
202*        9030 FORMAT (05X,40HX AXIS OF RECEPTOR GRID SYSTEM (X (M)) =,2(F9.1,1H,S0402020
203*          *)/(05X,6(F9.1,1H,)))                                              S0402030
204*        9031 FORMAT (05X,40HY AXIS OF RECEPTOR GRID SYSTEM (Y (M)) =,2(F9.1,1H,S0402040
205*          *)/(05X,6(F9.1,1H,)))                                              S0402050
206*        9032 FORMAT (05X,30HX DISCRETE RECEPTORS (X (M)) =,3(F9.1,1H,)/(05X,6(FS0402060
207*          *9.1,1H,)))                                                        S0402070
208*        9033 FORMAT (05X,30HY DISCRETE RECEPTORS (Y (M)) = 3(F9.1,1H,)/(05X,6(FS0402080
209*          *9.1,1H,)))                                                        S0402090
210*        9034 FORMAT (05X,54HSTART AND END X COORDINATES OF LINE SOURCES (DX (M)S0402100
211*          *) =/(05X,6(F9.1,1H,)))                                            S0402110
212*        9035 FORMAT (05X,54HSTART AND END Y COORDINATES OF LINE SOURCES (DY (M)S0402120
213*          *) =/(05X,6(F9.1,1H,)))                                            S0402130
214*        9036 FORMAT (05X,56HFRACTION OF SPRAY MATERIAL FOR EACH DROP CAT. (PCTMS0402140
215*          *AT) =,F7.5,1H,/(05X,8(F7.5,1H,)))                                 S0402150
216*        9037 FORMAT (05X,60HSETTLING VEL. SPECIFYING WHICH SET OF GAMA, GAMB ANS0402160
217*          *D GAMC TO/05X,19HUSE (VSGAM (M S)) =,F7.4,1H,,F7.4)               S0402170
218*        9038 FORMAT (05X,74HCOEFFICIENTS OF EQUATIONS GIVING SURF. REFLECT. COES0402180
219*          *FFS. (GAMA,GAMB,GAMC) =/(05X,5(E12.6,1H,)))                       S0402190
220*        9039 FORMAT (05X,44HDOSAGE LEVELS FOR AREA-OF-COVERAGE (DOSLV) =,E12.6,S0402200
221*          *1H,/(05X,5(E12.6,1H,)))                                           S0402210
222*        9040 FORMAT (05X,51HCONCENTRATION LEVELS FOR AREA-OF-COVERAGE (CONLV) =S0402220
223*          *,E12.6,1H,/(05X,5(E12.6,1H,)))                                    S0402230
224*        9041 FORMAT (05X,48HDEPOSITION LEVELS FOR AREA-OF-COVERAGE (DEPLV) =,E1S0402240
225*          *2.6,1H,/(05X,5(E12.6,1H,)))                                       S0402250
226*           END                                                               S0402260
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      SUBROUTINE CBGS3                                                  S0500010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0500020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0500030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0500040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0500050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0500060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0500070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0500080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0500090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0500100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0500110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0500120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0500130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0500140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0500150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0500160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0500170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0500180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0500190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0500200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0500210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0500220
      INTEGER TITLE                                                     S0500230
C                                                                       S0500240
C                                                                       S0500250
C                                                                       S0500260
C     SET ABOVE CANOPY FLAG                                             S0500270
      IFUP = 1                                                          S0500280
C     GO CALC. PARAMETERS FOR EVAPORATION MODEL FOR ABOVE CANOPY        S0500290
      CALL EVPMD                                                        S0500300
C     GO CALC. EVAPORATION FOR ABOVE CANOPY                             S0500310
      CALL EVPML                                                        S0500320
C     SET FRACTION OF MATERIAL REACHING CANOPY AND DISTANCE TRAVEL      S0500330
C     THROUGH CANOPY TO 1 AND 0, RESPECTIVELY IN CASE THERE IS NO       S0500340
C     CANOPY. USED LATER IN DISPERSION MODELS.                          S0500350
      DO 10 J=1,20                                                      S0500360
      DO 10 I=1,11                                                      S0500370
      CNTD(I,J) = 1.0                                                   S0500380
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39*          10 DISTM(I,J) = 0.0                                                S0500390
40*       C     IF NO CANOPY BRANCH                                             S0500400
41*             IF (ISW(3).LE. 0) GO TO 20                                      S0500410
42*       C     SET BELOW CANOPY FLAG                                           S0500420
43*             IFUP = 2                                                        S0500430
44*       C     GO CALC. PARAMETERS FOR BELOW CANOPY EVAPORATION                S0500440
45*             CALL EVPMD                                                      S0500450
46*       C     GO CALC. BELOW CANOPY EVAPORATION                               S0500460
47*             CALL EVPML                                                      S0500470
48*       C     GO CALC. CANOPY PENETRATION MODEL                               S0500480
49*             CALL CANPY                                                      S0500490
50*          20 CONTINUE                                                        S0500500
51*       C     IF NO DISPERSION MODEL CALCS. BRANCH                            S0500510
52*             IF (ISW(4) .LE. 0) GO TO 40                                     S0500520
53*       C     GO CALC. DISPERSION MODELS                                      S0500530
54*          30 CONTINUE                                                        S0500540
55*             CALL CBGS4                                                      S0500550
56*             RETURN                                                          S0500560
57*          40 WRITE (IOTFIL,9001)                                             S0500570
58*             STOP                                                            S0500580
59*        9001 FORMAT (31H1***** END OF FSCBG PROG. *****/1H1)                 S0500590
60*             END                                                             S0500600
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      SUBROUTINE EVPMD                                                  S0600010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0600020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0600030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0600040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0600050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0600060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0600070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0600080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0600090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0600100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0600110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0600120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0600130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0600140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0600150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0600160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0600170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0600180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0600190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0600200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0600210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0600220
      INTEGER TITLE                                                     S0600230
      PRSVP(A,B) = B*(575.0466+A*(31.82291+1.296028*A))/(93.51611-A)    S0600240
C     SUBROUTINE USED TO CALCULATE PARAMETERS USED IN THE EVAPORATION   S0600250
C     MODEL AND USED TO CALCULATE THE WAKE SETTLING VELOCITY.           S0600260
      IF (IFUP .EQ. 1) T2 = AIRTPO                                      S0600270
C     IFUP = 1 IS ABOVE CANOPY                                          S0600280
C     IFUP = 2 IS BELOW CANOPY                                          S0600290
      IF (IFUP .EQ. 2) T2 = AIRTPU                                      S0600300
      IF (VAPINF .GE. 0.0) GO TO 10                                     S0600310
C     PARAMETERS THAT ARE DEFAULTED ARE SET NEGATIVE SO WHEN THE BELOW  S0600320
C     CANOPY PASS IS MADE THEY WILL BE RECALCULATED FOR BELOW CANOPY    S0600330
C     CONDITIONS.                                                       S0600340
C     APPROX. VAPINF BY THAT OF WATER                                   S0600350
      IF (IFUP .EQ. 1) VAPINF = -PRSVP(T2,0.01*RELHMO)                  S0600360
      IF (IFUP .EQ. 2) VAPINF = -PRSVP(T2,0.01*RELHMU)                  S0600370
   10 CONTINUE                                                          S0600380
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      T2 = T2+273.16                                                    S0600390
      IF (AIRDEN .GT. 0.0) GO TO 20                                     S0600400
C     CALC. AIR DENSITY                                                 S0600410
      AIRDEN = -(1.202744181E-5*AIRMOL*(AIRPRS-.37803*ABS(VAPINF))/T2)  S0600420
   20 IF (CONMOL .GE. 0.0) GO TO 30                                     S0600430
C     APPROX. MOLAL CONCENTRATION                                       S0600440
      CONMOL = -ABS(AIRDEN)/AIRMOL                                      S0600450
   30 CONTINUE                                                          S0600460
      IF (IFWATR .LE. 1) GO TO 110                                      S0600470
C                                                                       S0600480
C                                                                       S0600490
C                                                                       S0600500
C                                                                       S0600510
C*********************************************************************  S0600520
C     DROP LIQUID IS NOT WATER                                          S0600530
C                                                                       S0600540
C                                                                       S0600550
C                                                                       S0600560
C     USE AIR TEMP. AS INITIAL GUESS AT DROP TEMP.                      S0600570
      T3 = T2                                                           S0600580
      T4 = AIRPRS*.75006168                                             S0600590
C     .75006168 IS 760/1013.25                                          S0600600
      T9 = 213.79575/AIRPRS                                             S0600610
C     213.79575 IS 0.211*1013.25                                        S0600620
      T10 = ABS(VAPINF)*.75006168                                       S0600630
      K = 1                                                             S0600640
C     START ITERATION LOOP                                              S0600650
   40 DRPPRS = EXP(BCONST-CCONST/T3)                                    S0600660
      IF (HETLAT .GT. 0.0) GO TO 50                                     S0600670
C     APPROX. HETLAT BY THAT FOR WATER, SETTING NEG. FOR FLAG.          S0600680
      HETLAT = -(597.3*(273.16/T3)**(0.107+3.67E-4*T3))*VAPMOL          S0600690
   50 CONTINUE                                                          S0600700
      IF (DFUSIV .GT. 0.0) GO TO 60                                     S0600710
C     APPROX. DFUSIV BY THAT FOR WATER, SETTING NEG. FOR FLAG.          S0600720
      DFUSIV = -(T9*(3.6608581E-3*T3)**1.94)                            S0600730
   60 CONTINUE                                                          S0600740
      IF (THERMC .GT. 0.0) GO TO 70                                     S0600750
C     APPROX. THERMC BY THAT FOR WATER, SETTING NEG. FOR FLAG.          S0600760
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77*            T7 = T3-273.16                                                    S0600770
78*            T1 = 5.69E-5+1.7E-7*T7                                            S0600780
79*            T7 = 3.78E-5+2.0E-7*T7                                            S0600790
80*            THERMC = -(T1*(1.0-(1.17-1.02*T7/T1))*ABS(VAPINF)/AIRPRS)         S0600800
81*         70 CONTINUE                                                          S0600810
82*            T1 = ABS(THERMC/(CONMOL*DFUSIV*HETLAT))                           S0600820
83*            T7 = T1*(T2-T3)                                                   S0600830
84*            T6 = 1.0+T7                                                       S0600840
85*            T8 = DRPPRS*T6                                                    S0600850
86*            T7 = T8-T7*T4-T10                                                 S0600860
87*            T8 = T8*(CCONST/(T3*T3))+T1*(T4-DRPPRS)                           S0600870
88*            DRPTMP = T3-T7/T8                                                 S0600880
89*            K = K+1                                                           S0600890
90*            IF (K .GT. 1000) GO TO 90                                         S0600900
91*            IF (DRPTMP .GT. 0.0) GO TO 80                                     S0600910
92*            T3 = T3*.66666667                                                 S0600920
93*            GO TO 40                                                          S0600930
94*         80 IF (ABS(DRPTMP-T3) .LE. 0.01) GO TO 100                           S0600940
95*            T3 = DRPTMP                                                       S0600950
96*            GO TO 40                                                          S0600960
97*         90 CONTINUE                                                          S0600970
98*            WRITE (IOTFIL,9001)                                               S0600980
99*            DRPTMP = T2                                                       S0600990
100*           DRPPRS = EXP(BCONST-CCONST/T2)                                    S0601000
101*        100 DRPTMP = DRPTMP-273.16                                           S0601010
102*           DRPPRS = DRPPRS*1.33322368                                        S0601020
103*     C     1.33322368 IS 1013.25/760                                         S0601030
104*           GO TO 170                                                         S0601040
105*     C                                                                       S0601050
106*     C*****************************************************************     S0601060
107*     C     LIQUID IS WATER                                                   S0601070
108*     C                                                                       S0601080
109*     C                                                                       S0601090
110*     C                                                                       S0601100
111*        110 K = 0                                                            S0601110
112*           T1 = 0.0                                                          S0601120
113*           IF (IFUP .EQ. 1) T2 = 0.01*RELHMO                                 S0601130
114*           IF (IFUP .EQ. 2) T2 = 0.01*RELHMU                                 S0601140
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115*            T12 = AIRTPO                                                    S0601150
116*            IF (IFUP .EQ. 2) T12 = AIRTPU                                   S0601160
117*      C     CALC. VAPOR PRESS. OF WATER AT INFINITY                         S0601170
118*            VAPINF = PRSVP(T12,T2)                                          S0601180
119*            IF (AIRDEN .GT. 0.0) GO TO 120                                  S0601190
120*            AIRDEN = -(1.202744181E-5*AIRMOL*(AIRPRS-.37803*VAPINF)/(T12+273.1S0601200
121*           *6))                                                             S0601210
122*      C     CALC. INITIAL GUESS FOR DROP TEMP.                              S0601220
123*        120 T3 = 0.0                                                        S0601230
124*            IF (T2 .GT. 0.0) T3 = T12*T2**0.3                               S0601240
125*            T4 = 1.0/AIRPRS                                                 S0601250
126*            T5 = T3+273.16                                                  S0601260
127*            T6 = 213.79575*T4                                               S0601270
128*      C     213.79575 IS 1013.25*0.211                                      S0601280
129*            T7 = 3.6608581E-3                                               S0601290
130*      C     3.6608581E-3 IS 1/273.16                                        S0601300
131*            T4 = T4*VAPINF                                                  S0601310
132*            T8 = 1.20274418E-5*VAPMOL                                       S0601320
133*      C     1.20274418E-5 IS 1.0E-4/8.31432                                 S0601330
134*            T9 = 0.25*T12                                                   S0601340
135*      C     CALC. LATENT HEAT OF VAPORIZATION AT DROP TEMP.                 S0601350
136*        130 HETLAT = 597.3*(273.16/T5)**(0.107+3.67E-4*T5)                  S0601360
137*      C     CALC. THE VAPOR PRESS. OF THE DROP AT THE DROP TEMP.            S0601370
138*            DRPPRS = PRSVP(T3,1.0)                                          S0601380
139*      C     CALC. THE DIFFUSIVITY AT THE DROP TEMP.                         S0601390
140*            DFUSIV = T6*(T5*T7)**1.94                                       S0601400
141*      C     CALC. THE THERMAL CONDUCTIVITY OF AIR AT THE DROP TEMP.         S0601410
142*            T10 = 5.69E-5+1.7E-7*T3                                         S0601420
143*            T11 = 3.78E-5+2.0E-7*T3                                         S0601430
144*            THERMC = T10*(1.0-(1.17-1.02*T11/T10)*T4)                       S0601440
145*      C     CALC. THE INITIAL GUESS FOR T11 (AIRTMP-DRPTMP) USING T10, THE  S0601450
146*      C     AVERAGE OF THE DROP TEMP. AND AIR TEMP.                         S0601460
147*            T10 = 0.5*(T12+T3)+273.16                                       S0601470
148*            T11 = HETLAT*DFUSIV*T8*(DRPPRS-VAPINF)/(THERMC*T10)             S0601480
149*      C     CALC. NEXT GUESS BY TAKING 1/4 OF THE NEW TO 3/4 OF THE OLD.    S0601490
150*            T3 = T9-0.25*T11+0.75*T3                                        S0601500
151*            T5 = T3+273.16                                                  S0601510
152*            IF (ABS(T3-T1) .LE. 0.001) GO TO 150                            S0601520
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153*            K = K+1                                                          S0601530
154*            IF (K .GT. 500) GO TO 140                                        S0601540
155*            T1 = T3                                                          S0601550
156*            GO TO 130                                                        S0601560
157*        140 WRITE (IOTFIL,9001)                                              S0601570
158*            DRPTMP = T12                                                     S0601580
159*            DRPPRS = PRSVP(T12,1.0)                                          S0601590
160*            GO TO 160                                                        S0601600
161*        150 DRPTMP = T3                                                      S0601610
162*        160 CONTINUE                                                         S0601620
163*      C                                                                      S0601630
164*      C                                                                      S0601640
165*      C                                                                      S0601650
166*        170 CONTINUE                                                         S0601660
167*            IF (IFUP .EQ. 2) GO TO 180                                       S0601670
168*      C                                                                      S0601680
169*      C                                                                      S0601690
170*      C                                                                      S0601700
171*      C                                                                      S0601710
172*      C**********************************************************************S0601720
173*      C     CALC. THE WAKE SETTLING VELOCITY, IF REQUIRED.                   S0601730
174*      C                                                                      S0601740
175*      C                                                                      S0601750
176*      C                                                                      S0601760
177*      C                                                                      S0601770
178*            IF (ISW(1) .NE. 0) WAKVEL = 2.52852E-3*ARCRWT/(ABS(AIRDEN)*ARCRSP*S0601780
179*           *WNGSPN*WNGSPN)                                                   S0601790
180*        180 CONTINUE                                                         S0601800
181*            T1 = AIRTPD                                                      S0601810
182*            IF (IFUP .EQ. 2) T1 = AIRTPU                                     S0601820
183*            T1 = T1+273.16                                                   S0601830
184*      C     CALC. THE ABSOLUTE VISCOSITY OF AIR                              S0601840
185*            ABSVSC = 1.49628635E-5*T1**1.5/(T1+296.16)                       S0601850
186*      C     PRE. CALC. EQUATION PARTS FOR EVAP MODEL                         S0601860
187*            T4 = ABSVSC/ABS(AIRDEN)                                          S0601870
188*      C     CALC. THE SCHMIDT NUMBER                                         S0601880
189*            SCHMDT = T4/ABS(DFUSIV)                                          S0601890
190*            T5 = 1.0/ABSVSC                                                  S0601900
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191*            T3 = DENLIQ*T5                                                  S0601910
192*            T2 = 10453.3333*T3*ABS(AIRDEN)*T5                               S0601920
193*            T3 = 217.77777*T3                                               S0601930
194*            T4 = 0.5*T4                                                     S0601940
195*            T5 = 2.0*ABS(AIRDEN)*T5                                         S0601950
196*            T6 = SCHMDT**.33333333                                          S0601960
197*            IF (IFWATR .EQ. 2) T6 = T6*0.3                                  S0601970
198*            T8 = 4.188790206*DENLIQ                                         S0601980
199*            T9 = WNGSPN*0.5                                                 S0601990
200*            T10 = WAKVEL*100.0                                              S0602000
201*            T7 = VAPMOL*ABS(DFUSIV*AIRDEN)*(DRPPRS-ABS(VAPINF))/(AIRMOL*    S0602010
202*           *DENLIQ*(AIRPRS-DRPPRS))                                         S0602020
203*            IF (ISW(5) .LT. 1) GO TO 190                                    S0602030
204*            CALL IOPUT(1,2,IFUP)                                            S0602040
205*            T13 = ABS(VAPINF)                                               S0602050
206*            T14 = ABS(CONMOL)                                               S0602060
207*            T15 = ABS(THERMC)                                               S0602070
208*            T16 = ABS(HETLAT)                                               S0602080
209*            T17 = ABS(DFUSIV)                                               S0602090
210*            T12 = ABS(AIRDEN)                                               S0602100
211*            WRITE (IOTFIL,9002) T13,T12,T14,T17,T15,T16,DRPPRS,DRPTMP,      S0602110
212*           *WAKVEL                                                          S0602120
213*            WRITE (IOTFIL,9003) ABSVSC,SCHMDT                               S0602130
214*            IF (ISW(5) .LT. 2) GO TO 190                                    S0602140
215*            WRITE (IOTFIL,9004) T1,T2,T3,T4,T5,T6,T7,T8,T9,T10              S0602150
216*     190 CONTINUE                                                           S0602160
217*            RETURN                                                          S0602170
218*        9001 FORMAT (63H *** WARNING - UNABLE TO CALC. DROP TEMP., PROG  USES AS0602180
219*           *IR TEMP.)                                                       S0602190
220*        9002 FORMAT (10X,38HVAPOR PRESSURE OF LIQUID AT INFINITY =,E14.8,5H (MBS0602200
221*           *)/10X,13HAIR DENSITY =,E14.8,10H (G/CM**3)/10X,43HMOLAL CONCENTRATS0602210
222*           *ION OF AIR-LIQUID MIXTURE =,E14.8,10H (G/CM**3)/10X,67HDIFFUSIVITYS0602220
223*           * OF EVAPORATING VAPOR INTO AIR AT THE DROP TEMPERATURE =,E14.8,12HS0602230
224*           * (CM**2/SEC)/10X,68HTHERMAL CONDUCTIVITY OF THE VAPOR INTO AIR AT S0602240
225*           *THE DROP TEMPERATURE =,E14.8,24H (CAL/(SEC CM.DEGREE K))/10X,53HLAS0602250
226*           *TENT HEAT OF VAPORIZATION AT THE DROP TEMPERATURE =,E14.8,11H (CALS0602260
227*           */MOLE)/10X,15HDROP PRESSURE =,E14.8,5H (MB)/10X,19HDROP TEMPERATURS0602270
228*           *E =,E14.8,12H (DEGREES C)/10X,24HWAKE SETTLING VELOCITY =,E14.8,6HS0602280
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229*          * (M/S))                                                          S0602290
230*      9003 FORMAT (10X,32HABSOLUTE VISCOSITY (GM/CM/SEC) =,E14.8/           S0602300
231*          *10X,16HSCHMIDT NUMBER =,E14.8)                                   S0602310
232*      9004 FORMAT (39H DIAG - T1,T2,T3,T4,T5,T6,T7,T8,T9,T10=,5E14.8/(1X,   S0602320
233*          *9E14.8))                                                         S0602330
234*           END                                                              S0602340
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      SUBROUTINE EVPML                                                  S0700010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0700020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0700030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0700040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0700050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0700060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0700070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0700080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0700090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0700100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0700110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0700120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0700130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0700140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0700150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0700160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0700170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0700180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0700190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0700200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0700210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0700220
      DIMENSION DRPTP(100),DRPBP(100),TMLSP(100),TMSS(100),TIMT(100)    S0700230
     *,TMASS(100)                                                       S0700230
      INTEGER TITLE                                                     S0700240
C     EVAPORATION MODEL PROGRAM. THIS SUBROUTINE LOOPS OVER EACH DROP   S0700250
C     SIZE CATEGORY, CALCULATING THE EVAPORATION RATE AND ALL RELATED   S0700260
C     INFORMATION REQUIRED BY THE CANOPY PENETRATION MODEL AND THE      S0700270
C     DISPERSION MODELS.                                                S0700280
C                                                                       S0700290
C     BEGIN LOOP OVER DROP SIZE CATEGORIES                              S0700300
      IA = 1H1                                                          S0700310
      DO 650 K=1,NVS                                                    S0700320
      FCT = 1.0                                                         S0700330
C     FCT IS A MULTIPLIER ON DELTA-H THE ITERATION HEIGHT INTERVAL. IF   S0700340
C     THE DELTA-H USED DOES NOT PROVIDE ENOUGH POINTS FOR AN ACCURATE   S0700350
C     REGRESSION ANALYSIS THE VALUE OF FCT IS CHANGED TO PROVIDE MORE   S0700360
C     POINTS AND THE PROGRAM REPEATS THE ITERATION.                     S0700370
      GO TO 20                                                          S0700380
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      SUBROUTINE EVPML                                                  S0700010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0700020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0700030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0700040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0700050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0700060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0700070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0700080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0700090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0700100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0700110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0700120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0700130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S0700140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0700150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0700160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0700170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0700180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0700190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0700200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0700210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0700220
      DIMENSION DRPTP(100),DRPBP(100),TMLSP(100),TMSS(100),TIMT(100)    S0700230
      INTEGER TITLE                                                     S0700240
C     EVAPORATION MODEL PROGRAM. THIS SUBROUTINE LOOPS OVER EACH DROP   S0700250
C     SIZE CATEGORY, CALCULATING THE EVAPORATION RATE AND ALL RELATED   S0700260
C     INFORMATION REQUIRED BY THE CANOPY PENETRATION MODEL AND THE      S0700270
C     DISPERSION MODELS.                                                S0700280
C                                                                       S0700290
C     BEGIN LOOP OVER DROP SIZE CATEGORIES                              S0700300
      IA = 1H1                                                          S0700310
      DO 650 K=1,NVS                                                    S0700320
      FCT = 1.0                                                         S0700330
C     FCT IS A MULTIPLIER ON DELTA-H THE ITERATION HEIGHT INTERVAL. IF   S0700340
C     THE DELTA-H USED DOES NOT PROVIDE ENOUGH POINTS FOR AN ACCURATE   S0700350
C     REGRESSION ANALYSIS THE VALUE OF FCT IS CHANGED TO PROVIDE MORE   S0700360
C     POINTS AND THE PROGRAM REPEATS THE ITERATION.                     S0700370
      GO TO 20                                                          S0700380
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39*          10 FCT = FCT*0.5                                                    S0700390
40*          20 CONTINUE                                                         S0700400
41*             IF (ISW(5) .GE. 2) WRITE (IOTFIL,9001) IA,K,FCT,IFUP,            S0700410
42*            *HGTCFT                                                          S0700420
43*             IA = 1H                                                         S0700430
44*             N = 0                                                           S0700440
45*       C     SUBROUTINE CONTROL FLAGS                                        S0700450
46*             IF1 = 0                                                         S0700460
47*             IF2 = 0                                                         S0700470
48*             IF3 = 0                                                         S0700480
49*             IF4 = 0                                                         S0700490
50*             IF5 = 0                                                         S0700500
51*             IF6 = 0                                                         S0700510
52*             DRPTOL = 0.0                                                    S0700520
53*             DRPBOL = 0.0                                                    S0700530
54*             LINE = 57                                                       S0700540
55*             M = 0                                                           S0700550
56*       C     CONVERT DROP SIZE TO RADIUS IN CM                               S0700560
57*             RD(1) = DRPUPR(K)*5.0E-5                                        S0700570
58*             RD(2) = DRPLWR(K)*5.0E-5                                        S0700580
59*             TMLS = 0.0                                                      S0700590
60*       C     IF BELOW CANOPY BRANCH                                          S0700600
61*             IF (IFUP .EQ. 2) GO TO 30                                       S0700610
62*       C     SET ABOVE CANOPY PARAMETERS                                     S0700620
63*             RELHM = RELHM0                                                  S0700630
64*       C     XLOC IS HORIZONTAL TRAVEL DISTANCE                              S0700640
65*             XLOC = 0.0                                                      S0700650
66*       C     TIME IS TIME OF TRAVEL                                          S0700660
67*             TIME = 0.0                                                      S0700670
68*       C     TMLST IS TOTAL MASS LOST DUE TO EVAPORATION                     S0700680
69*             TMLST = 0.0                                                     S0700690
70*       C     HI IS THE HEIGHT OF THE DROP                                    S0700700
71*             HI = HGTCFT                                                     S0700710
72*       C     XLOCS IS AN ARRAY IN WHICH THE DISTANCE OF THE DROP TO THE POINT S0700720
73*       C     THE DROP ENTERS THE CANOPY IS SAVED FOR DROP SIZE CATEGORY K.   S0700730
74*             XLOCS(K) = 0.0                                                  S0700740
75*       C     VSSS IS AN ARRAY IN WHICH THE SETTLING VELOCITY OF THE DROP AS THES0700750
76*       C     DROP ENTERS THE CANOPY IS SAVED                                 S0700760
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77*                VSSS(K) = 0.0                                                  S0700770
78*      C         TIMO IS AN ARRAY IN WHICH THE TIME OF TRAVEL IS SAVED WHEN ISW(2) S0700780
79*      C         = 2. TIMO IS TIME USED WHEN THE USER HAS SPECIFIED THE RATE OF  S0700790
80*      C         EVAPORATION VIA DAU, DBU, DCU, DAL, DBL AND DCL.                S0700800
81*                TIMO(K) = 0.0                                                  S0700810
82*      C         TMLSO IS AN ARRAY IN WHICH THE FRACTION OF MATERIAL REACHING THE S0700820
83*      C         CANOPY HEIGHT IS SAVE FOR DROP CATEGORY K.                      S0700830
84*                TMLSO(K) = 0.0                                                 S0700840
85*                GO TO 90                                                       S0700850
86*      C         SET PARAMETERS FOR BELOW CANOPY EVAPORATION                     S0700860
87*      C         SET DISTANCE OF DROP TRAVEL TO TOP OF CANOPY                    S0700870
88*           30   XLOC = XLOCS(K)                                                S0700880
89*                RELHM = RELHMU                                                 S0700890
90*      C         SET TIME TO TOP OF CANOPY                                      S0700900
91*                TIME = TIMO(K)                                                 S0700910
92*      C         SET FRACTION OF MATERIAL REACHING TOP OF CANOPY                 S0700920
93*                TMLST = TMLSO(K)                                               S0700930
94*      C         SET HEIGHT TO TOP OF CANOPY                                     S0700940
95*                HI = HGTCAN(1)                                                 S0700950
96*      C         CHECK TO SEE IF USER HAS SPECIFIED EVAPORATION RATE             S0700960
97*                IF (ISW(2) .NE. 2) GO TO 90                                    S0700970
98*      C         USER HAS SPECIFIED EVAPORATION RATE                             S0700980
99*      C         USER HAS INPUT DROP VS. TIME FUNCTION                           S0700990
100*     C         SOLVE FOR TIME FOR DROP SIZE AT TOP OF CANOPY                   S0701000
101*               IF (DCL(K)) 40,50,40                                           S0701010
102*          40   T16 = DBL(K)*DBL(K)-4.0*(DAL(K)-DRPUPR(K))*DCL(K)              S0701020
103*               IF (T16 .LT. 0.0) T16 = 0.0                                    S0701030
104*     C         TIML IS TIME FOR BELOW CANOPY WHEN USER INPUTS DROP VS. TIME    S0701040
105*     C         EQUATIONS                                                       S0701050
106*               TIML = (-DBL(K)-SQRT(T16))/(2.0*DCL(K))                        S0701060
107*               GO TO 80                                                       S0701070
108*          50   IF (DBL(K)) 60,70,60                                          S0701080
109*          60   TIML = (DRPUPR(K)-DAL(K))/DBL(K)                             S0701090
110*               GO TO 80                                                       S0701100
111*          70   TIML = 0.0                                                    S0701110
112*          80   CONTINUE                                                      S0701120
113*          90   CONTINUE                                                      S0701130
114*               HLAST = HI                                                     S0701140
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115*            IF (ISW(2) .EQ. 2) GO TO 100                                    S0701150
116*      C     CALC. THE AVERAGE DROP RADIUS USING GEOMETRIC MEAN.             S0701160
117*            RD(3) = AVGRD(RD(1),RD(2))                                      S0701170
118*            GO TO 130                                                       S0701180
119*        100 IF (IFUP .EQ. 2) GO TO 110                                      S0701190
120*      C     ABOVE CANOPY - USER HAS INPUT DROP VS. TIME                     S0701200
121*            DRPUPR(K) = DAU(K)+TIME*(DBU(K)+TIME*DCU(K))                    S0701210
122*            GO TO 120                                                       S0701220
123*      C     BELOW CANOPY - USER HAS INPUT DROP VS. TIME                     S0701230
124*        110 DRPUPR(K) = DAL(K)+TIML*(DBL(K)+TIML*DCL(K))                    S0701240
125*        120 DRPLWR(K) = DRPUPR(K)                                           S0701250
126*            RD(1) = DRPUPR(K)*5.0E-5                                        S0701260
127*            RD(2) = RD(1)                                                   S0701270
128*            RD(3) = RD(1)                                                   S0701280
129*        130 CONTINUE                                                        S0701290
130*            IF (DRPUPR(K) .LE. 0.0) GO TO 540                               S0701300
131*      C     CALC. DELTA H                                                   S0701310
132*            DELTH = HI*0.0166666*FCT                                        S0701320
133*            DELTAH = DELTH                                                  S0701330
134*            IF (IFUP .EQ. 2) GO TO 140                                      S0701340
135*      C     SAVE THE AVERAGE DROP SIZE AT THE TOP FOR LATER USE WITH BELOW  S0701350
136*      C     CANOPY EVAP.                                                    S0701360
137*            RDST(K) = RD(3)                                                 S0701370
138*        140 CONTINUE                                                        S0701380
139*      C     RDSTI IS COSTANT USED IN CALCULATION OF FRACTION OF MATERIAL    S0701390
140*      C     REACHING HEIGHT. THE FRACTION IS CALCULATED BY THE DROP VOLUME  S0701400
141*      C     NOW DIVIDED BY THE ORIGINAL DROP VOLUME.                        S0701410
142*            RDSTI = 1.0/(RDST(K)*RDST(K)*RDST(K))                           S0701420
143*            N = 1                                                           S0701430
144*      C     N IS THE NUMBER OF ITERATIVE POINTS SAVED                       S0701440
145*      C     SAVE UPPER DIAMETER IN MICROMETERS                              S0701450
146*            DRPTP(N) = RD(1)*2.0E4                                          S0701460
147*      C     SAVE LOWER DIAMETER IN MICROMETERS                              S0701470
148*            DRPBP(N) = RD(2)*2.0E4                                          S0701480
149*      C     SAVE MEAN DIAMETER IN MICROMETERS                               S0701490
150*            DRPDM(N) = RD(3)*2.0E4                                          S0701500
151*      C     SAVE PERCENTAGE OF MATERIAL                                     S0701510
152*            TMSLO(N) = 100.0*RD(3)*RD(3)*RD(3)*RDSTI                        S0701520
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115*            IF (ISW(2) .EQ. 2) GO TO 100                                    S0701150
116*      C     CALC. THE AVERAGE DROP RADIUS USING GEOMETRIC MEAN.             S0701160
117*            RD(3) = AVGRD(RD(1),RD(2))                                      S0701170
118*            GO TO 130                                                       S0701180
119*        100 IF (IFUP .EQ. 2) GO TO 110                                      S0701190
120*      C     ABOVE CANOPY - USER HAS INPUT DROP VS. TIME                     S0701200
121*            DRPUPR(K) = DAU(K)+TIME*(DBU(K)+TIME*DCU(K))                    S0701210
122*            GO TO 120                                                       S0701220
123*      C     BELOW CANOPY - USER HAS INPUT DROP VS. TIME                     S0701230
124*        110 DRPUPR(K) = DAL(K)+TIML*(DBL(K)+TIML*DCL(K))                    S0701240
125*        120 DRPLWR(K) = DRPUPR(K)                                           S0701250
126*            RD(1) = DRPUPR(K)*5.0E-5                                        S0701260
127*            RD(2) = RD(1)                                                   S0701270
128*            RD(3) = RD(1)                                                   S0701280
129*        130 CONTINUE                                                        S0701290
130*            IF (DRPUPR(K) .LE. 0.0) GO TO 540                               S0701300
131*      C     CALC. DELTA H                                                   S0701310
132*            DELTH = HI*0.0166666*FCT                                        S0701320
133*            DELTAH = DELTH                                                  S0701330
134*            IF (IFUP .EQ. 2) GO TO 140                                      S0701340
135*      C     SAVE THE AVERAGE DROP SIZE AT THE TOP FOR LATER USE WITH BELOW  S0701350
136*      C     CANOPY EVAP.                                                    S0701360
137*            RDST(K) = RD(3)                                                 S0701370
138*        140 CONTINUE                                                        S0701380
139*      C     RDSTI IS COSTANT USED IN CALCULATION OF FRACTION OF MATERIAL    S0701390
140*      C     REACHING HEIGHT. THE FRACTION IS CALCULATED BY THE DROP VOLUME  S0701400
141*      C     NOW DIVIDED BY THE ORIGINAL DROP VOLUME.                        S0701410
142*            RDSTI = 1.0/(RDST(K)*RDST(K)*RDST(K))                           S0701420
143*            N = 1                                                           S0701430
144*      C     N IS THE NUMBER OF ITERATIVE POINTS SAVED                       S0701440
145*      C     SAVE UPPER DIAMETER IN MICROMETERS                              S0701450
146*            DRPTP(N) = RD(1)*2.0E4                                          S0701460
147*      C     SAVE LOWER DIAMETER IN MICROMETERS                              S0701470
148*            DRPBP(N) = RD(2)*2.0E4                                          S0701480
149*      C     SAVE MEAN DIAMETER IN MICROMETERS                               S0701490
150*            DRPDM(N) = RD(3)*2.0E4                                          S0701500
151*      C     SAVE PERCENTAGE OF MATERIAL                                     S0701510
151*            TMASS(N) = RD(3)*RD(3)*RD(3)                                    S0701511
152*            TMSLO(N) = 100.0*TMASS(N)*RDSTI                                 S0701520
152*      C     SAVE TOTAL MASS                                                 S0701521
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152*            TMASS(N) = TMASS(N)*4.18879*DENLIQ                    S0701522
153*      C     SAVE HEIGHT                                           S0701530
154*            HIO(N) = HI                                           S0701540
155*      C     SAVE DISTANCE                                         S0701550
156*            XDO(N) = XLOC                                         S0701560
157*      C     SAVE TOTAL MASS LOST                                  S0701570
158*            TMLSP(N) = TMLST                                      S0701580
159*      C     SAVE MASS LOST IN HEIGHT INTERVAL                     S0701590
160*            TMSS(N) = 0.0                                         S0701600
161*      C     SAVE TIME                                             S0701610
162*            TIMT(N) = TIME                                        S0701620
163*      C     SET NEW DROP RADIUS TO OLD DROP RADIUS                S0701630
164*            RDN(1) = RD(1)                                        S0701640
165*            RDN(2) = RD(2)                                        S0701650
166*            RDN(3) = RD(3)                                        S0701660
167*      C     GO CALCULATE DROP SETTLING VELOCITY IN CM/SEC         S0701670
168*            CALL TRMVL                                            S0701680
169*      C     SET SETTLING VELOCITY OF MEAN DROP (M/S)              S0701690
170*            VSSO(N) = VSI(3)*0.01                                 S0701700
171*        150 CONTINUE                                              S0701710
172*        160 CONTINUE                                              S0701720
173*      C     BRANCH IF USER SPECIFIED EVAP. RATE                   S0701730
174*            IF (ISW(2) .EQ. 2) GO TO 270                          S0701740
175*      C     CALC. REYNOLDS NUMBER FOR UPPER AND LOWER DROP SIZES  S0701750
176*            DO 170 I=1,2                                          S0701760
177*        170 RN(I) = T5*VSI(I)*RD(I)                               S0701770
178*      C     CALC. SHERWOOD NUMBERS                                S0701780
179*      C     BRANCH IF NOT WATER                                   S0701790
180*            IF (IFWATR .EQ. 2) GO TO 200                          S0701800
181*      C     SHERWOOD NUMBERS FOR WATER, DEVELOPED FROM EXPERIMENTS OF  S0701810
182*      C     PRUPPACHER AND RASMUSSEN (1979)                       S0701820
183*            DO 190 I=1,2                                          S0701830
184*            T16 = T6*SQRT(RN(I))                                  S0701840
185*            IF (T16 .GT. 1.4) GO TO 180                           S0701850
186*            FV(I) = 1.0+0.108*T16                                 S0701860
187*            GO TO 190                                             S0701870
188*        180 FV(I) = 0.78+0.308*T16                                S0701880
189*        190 CONTINUE                                              S0701890
190*            GO TO 220                                             S0701900
191*      C     SHERWOOD NUMBERS FOR NON-WATER                        S0701910
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192*        200 DO 210 I=1,2                                                    S0701920
193*        210 FV(I) = 1.0+T6*SQRT(RN(I))                                      S0701930
194*        220 CONTINUE                                                        S0701940
195*      C     CALC. RATE OF CHANGE OF DROP RADIUS WITH TIME (T16)             S0701950
196*            DO 260 I=1,2                                                    S0701960
197*            T16 = T7*FV(I)/RD(I)                                            S0701970
197*            IF (T16 .LT. 0.0) T16 = 0.0                                     S0701971
198*      C     ADJUST TIME INCREMENT SO THAT (DRDT)*DT IS LESS THAN OR EQUAL TO S0701980
199*      C     0.2% OF THE DROP RADIUS. FOR THIS DETERMINATION THE AVERAGE DROP S0701990
200*      C     RADIUS AT THE BEGINNING OF THE TIME STEP WILL BE USED.          S0702000
201*      C                                                                     S0702010
202*      C     IF6 IS FLAG TO FORCE AT LEAST ONE OF THE CALCULATION HEIGHTS TO S0702020
203*      C     BE EQUAL TO HGTCAN(1).                                          S0702030
204*            IF (I .GT. 1.OR.IF6 .EQ. 1) GO TO 250                           S0702040
205*      C     ONLY SET DT FROM THE FIRST CALC. OR DR/DT                       S0702050
205*            DT = 0.0                                                        S0702051
206*            IF (T16 .GT. 0.0) DT = 2.0E-3*RD(3)/T16                         S0702060
207*            IF (DT .LT. 0.02) DT = 0.02                                     S0702070
208*            IF (IF4.NE.0.OR.IFUP.EQ.2.OR.WNGSPN.LE.0.0) GO TO 230           S0702080
209*            IF (T9 .GE. HI-HGTCAN(1)) GO TO 230                             S0702090
210*            IF (IF5 .NE. 0.OR.T10 .GT. VSI(3)) GO TO 240                    S0702100
211*        230 VSPT = VSI(3)*0.01                                              S0702110
212*            GO TO 245                                                       S0702120
213*        240 VSPT = WAKVEL                                                   S0702130
213*            IF (VSPT .LE. 0.0) GO TO 230                                    S0702131
213*        245 DTPT = DELTAH/VSPT                                              S0702132
213*            IF (VSPT*DT .GT. DELTAH) DT = DTPT                              S0702133
213*            IF (ISW(2) .GT. 0.AND.RELHM .LT. 100.0) GO TO 250               S0702134
213*            IF (VSPT*DT .LT. 0.5*DELTAH) DT = 0.5*DTPT                      S0702135
214*      C     CALC. NEW DROP RADIUS                                           S0702140
215*        250 T16 = T16*DT                                                    S0702150
216*      C     IF NO EVAPORATION                                               S0702160
217*            IF (ISW(2) .EQ. 0) T16 = 0.0                                    S0702170
218*            RDN(I) = RD(I)-T16                                              S0702180
219*        260 CONTINUE                                                        S0702190
220*            GO TO 310                                                       S0702200
221*        270 DT = DELTAH/(0.01*VSI(3))                                       S0702210
222*        280 IF (IFUP .EQ. 2) GO TO 290                                      S0702220
223*      C     ABOVE CANOPY                                                    S0702230
224*            RDN(1) = (DAU(K)+(TIME+DT)*(DBU(K)+(TIME+DT)*DCU(K)))*5.0E-5    S0702240
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225*            GO TO 300                                                       S0702250
226*      C     BELOW CANOPY                                                    S0702260
227*        290 RDN(1) = (DAL(K)+(TIML+DT)*(DBL(K)+(TIML+DT)*DCL(K)))*5.0E-5    S0702270
228*        300 RDN(2) = RDN(1)                                                 S0702280
229*            RDN(3) = RDN(1)                                                 S0702290
230*        310 CONTINUE                                                        S0702300
231*            IF (RDN(2) .GT. 1.0E-4) GO TO 320                               S0702310
232*            IF3 = 1                                                         S0702320
233*            RDN(2) = 1.0E-4                                                 S0702330
234*        320 CONTINUE                                                        S0702340
235*            IF (ISW(2) .EQ. 2) GO TO 330                                    S0702350
236*      C     CALC. NEW AVERAGE RADIUS OF DROP                                S0702360
237*            RDN(3) = AVGRD(RDN(1),RDN(2))                                   S0702370
238*      C     CALC. THE MASS LOST FROM THE AVERAGE DROP                       S0702380
239*        330 T16 = T8*(RD(3)*RD(3)*RD(3)-RDN(3)*RDN(3)*RDN(3))               S0702390
240*      C     INCREMENT THE TOTAL MASS LOST                                   S0702400
241*            TMLST = TMLST+T16                                               S0702410
242*      C     INCREMENT THE MASS LOST IN DELTA-H                              S0702420
243*            TMLS = TMLS+T16                                                 S0702430
244*      C     CALC. THE NEW HEIGHT OF THE DROP LOCATION AND INCREMENT TIME    S0702440
245*            IF (IF6 .EQ. 1) GO TO 370                                       S0702450
246*            IF (IF4 .NE. 0) GO TO 340                                       S0702460
247*            IF (IFUP .EQ. 2) GO TO 340                                      S0702470
248*            IF(WNGSPN .LE. 0.0) GO TO 340                                   S0702480
249*      C     WHEN WNGSPN IS ZERO WE ASSUME NO WING VORTEX IS FORMED          S0702490
250*            T17 = HI-HGTCAN(1)                                              S0702500
251*      C     WHEN THE WING TIP VORTEX TOUCHES THE CANOPY IT BREAKS UP AND DROPSS0702510
252*      C     FALL AT VSI. T9 IS WNGSPN/2.0.                                  S0702520
253*            IF (T9 .GE. T17) GO TO 340                                      S0702530
254*      C     IF WAKVEL IS GREATER THAN VSI, IT WILL ALWAYS BE GREATER.       S0702540
255*            IF (IF5 .NE. 0) GO TO 360                                       S0702550
256*            IF (T10 .GT. VSI(3)) GO TO 350                                  S0702560
257*      C     T10 IS 100*WAKVEL, THE FACTOR 100 CONVERTS WAKVEL INTO CM/SEC.  S0702570
258*      C     THE FIRST TIME THROUGH IF WAKVEL IS NOT GREATER THAN VSI, WE WANT S0702580
259*      C     TO SET IF4 TO 1 SO THAT WE FALL OUT OF THE VORTEX. OTHERWISE THERES0702590
260*      C     WOULD BE A TIME WHEN VSI WOULD DECREASE BELOW WAKVEL, BUT BY THEN S0702600
261*      C     THE DROPS ARE NO LONGER IN THE VORTEX.                          S0702610
262*            IF4 = 1                                                         S0702620
263*        340 DZ = 0.01*VSI(3)*DT                                             S0702630
264*      C     FACTOR OF 0.01 CONVERTS VSI TO MPS.                             S0702640
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      GO TO 370                                                          S0702650
C     WHEN THE DROPS ARE IN A WING TIP VORTEX WHICH HAS A FALL VELOCITY  S0702660
C     WAKVEL GREATER THAN THE DROP TERMINAL VELOCITY, THE DROPS FALL AT  S0702670
C     THE VORTEX VELOCITY. IF WAKVEL IS LESS THAN VSI, THE DROPS FALL    S0702680
C     OUT OF THE VORTEX AND FALL AT VSI.                                 S0702690
  350 IF5 = 1                                                            S0702700
  360 DZ = WAKVEL*DT                                                     S0702710
  370 CONTINUE                                                           S0702720
      IF (IFUP .EQ. 2.OR.IF6 .NE. 0) GO TO 390                           S0702730
C     FIND POINT WHERE HEIGHT IS AT OR NEAR CANOPY HEIGHT SO WE CAN      S0702740
C     CALCULATE PARAMETERS FOR THE CANOPY HEIGHT.                        S0702750
      IF (HI-DZ .GT. HGTCAN(1)+.1.OR.HGTCAN(1) .LE. 0.0) GO TO 390       S0702760
C     AT OR NEAR CANOPY HEIGHT                                           S0702770
      T15 = HI-DZ                                                        S0702780
C     IF AT CANOPY HEIGHT BRANCH                                         S0702790
      IF (HGTCAN(1)-.1.LE.T15.AND.T15.LE.HGTCAN(1)+.1) GO TO 380         S0702800
C     WE HAVE GONE TOO FAR, MUST RECALCULATE DZ AND DT TO END UP AT      S0702810
C     CANOPY HEIGHT.                                                     S0702820
      DZ = HI-HGTCAN(1)                                                  S0702830
      DT = DZ/(0.01*VSI(3))                                              S0702840
C     SET FLAG TO INDICATE WE ARE RESETTING DZ, DT                       S0702850
      IF6 = 1                                                            S0702860
      TMLST = TMLST-T16                                                  S0702870
      TMLS = TMLS-T16                                                    S0702880
      IF (ISW(2) .EQ. 2) GO TO 280                                       S0702890
      IF (IF5 .EQ. 1) DT = DZ/WAKVEL                                     S0702900
      GO TO 220                                                          S0702910
  380 IF6 = 1                                                            S0702920
  390 CONTINUE                                                           S0702930
C     INCREMENT TIME                                                     S0702940
      TIME = TIME+DT                                                     S0702950
      IF (IFUP .EQ. 2) TIML = TIML+DT                                    S0702960
C     CALC. THE MIDPOINT OF THE HEIGHT OF THE LAST INTERVAL,             S0702970
      HMID = HI-0.5*DZ                                                   S0702980
C     CALC. NEW DROP HEIGHT                                              S0702990
      HI = HI-DZ                                                         S0703000
C     DETERMINE WIND SPEED                                               S0703010
      IF (IFUP .EQ. 2) GO TO 400                                         S0703020
C     USE WIND SPEED ABOVE CANOPY                                        S0703030
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304*            UBAR = WSOCAN                                                   S0703040
305*            GO TO 450                                                       S0703050
306*      C     USE WIND SPEED WITHIN CANOPY                                    S0703060
307*        400 IF (HI .GE. 0.75*HGTCAN(1)) GO TO 430                           S0703070
308*            IF (HI .GE. 0.50*HGTCAN(1)) GO TO 420                           S0703080
309*            IF (HI .GE. 0.25*HGTCAN(1)) GO TO 410                           S0703090
310*            UBAR = WSIN14                                                   S0703100
311*            GO TO 440                                                       S0703110
312*        410 UBAR = WSIN24                                                   S0703120
313*            GO TO 440                                                       S0703130
314*        420 UBAR = WSIN34                                                   S0703140
315*            GO TO 440                                                       S0703150
316*        430 UBAR = WSIN44                                                   S0703160
317*        440 IF (UBAR .LE. 0.0) UBAR = WSOCAN                                S0703170
318*        450 IF (UBAR .LE. 0.0) UBAR = 1.0E-6                                S0703180
319*      C     CALC. ANGLE OF DROP TRAJECTORY WITH HORIZONTAL                  S0703190
320*            ANG = 57.295779*ATAN(0.01*VSI(3)/UBAR)                          S0703200
321*      C     DETERMINE HORIZONTAL POSITION OF DROP                           S0703210
322*            XLOC = XLOC+UBAR*DT                                             S0703220
323*      C     CALC DROP SETTLING VELOCITY                                     S0703230
324*            CALL TRMVL                                                      S0703240
325*      C     WHEN THE DROP IS SMALL ENOUGH THAT THE SIZE IS LESS THAN 5 MICRO- S0703250
326*      C     METERS WE ASSUME THIS IS VAPOR AND STOP THE CALCULATIONS        S0703260
327*        460 IF (HLAST-HI .GE. DELTAH-.001.OR.IF6 .EQ. 1) IF1 = 1            S0703270
328*            IF (RDN(3).LE.2.5E-4.OR.VSI(3).LE.0.02) IF2 = 1                 S0703280
329*            IF (IFUP .EQ. 2.AND.HI .LT. 0.0) IF2 = 1                        S0703290
330*            IF (HI .LT. -10000.0) IF2 = 1                                   S0703291
331*            IF (ISW(2) .EQ. 0.AND.HI .LT. 0.0) IF2 = 1                      S0703300
332*            IF (ISW(2) .EQ. 1.AND.RELHM .GE. 099.0.AND.HI .LT. 0.0) IF2 = 1 S0703310
333*            DRPTO = RDN(1)*2.0E4                                            S0703320
334*            DRPBO = RDN(2)*2.0E4                                            S0703330
335*            DRPDI = RDN(3)*2.0E4                                            S0703340
336*            VST = VSI(3)*0.01                                               S0703350
337*            IF (IF1 .EQ. 0.AND.IF2 .EQ. 0) GO TO 470                        S0703360
338*      C     INCREMENT COUNTER AND SET PARAMETERS TO NEXT ITERATIVE VALUE    S0703370
339*            N = N+1                                                         S0703380
340*            DRPDM(N) = DRPDI                                                S0703390
340*            TMASS(N) = RDN(3)*RDN(3)*RDN(3)                                 S0703391
341*            TMSLO(N) = 100.0*TMASS(N)*RDSTI                                 S0703400
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341*            TMASS(N) = TMASS(N)*4.18879*DENLIQ                              S0703401
342*            HIO(N) = HI                                                     S0703410
343*            XDO(N) = XLOC                                                   S0703420
344*            VSSO(N) = VST                                                   S0703430
345*            DRPTP(N) = DRPTO                                                S0703440
346*            DRPBP(N) = DRPBO                                                S0703450
347*            TMLSP(N) = TMLST                                                S0703460
348*            TMSS(N) = TMLS                                                  S0703470
349*            TMLS = 0.0                                                      S0703480
350*            TIMT(N) = TIME                                                  S0703490
351*            IF (M .EQ. 0.AND.HI .LE. 0.0) M = N                             S0703500
352*          470 CONTINUE                                                      S0703510
353*            IF (IF6 .NE. 1.OR.IFUP .EQ. 2.OR.HGTCAN(1) .LE. 0.0) GO TO 480  S0703520
354*            IF6 = 2                                                         S0703530
355*        C   SAVE PARAMETERS AT CANOPY HEIGHT FOR LATER BELOW CANOPY CALCS.  S0703540
356*            DRPTOL = DRPTO                                                  S0703550
357*            DRPBOL = DRPBO                                                  S0703560
358*            XLOCS(K) = XLOC                                                 S0703570
359*            TIMO(K) = TIME                                                  S0703580
360*            TMLSO(K) = TMLST                                                S0703590
361*            VSSS(K) = VST                                                   S0703600
362*          480 CONTINUE                                                      S0703610
363*          490 IF (IF2 .NE. 0) GO TO 530                                     S0703620
364*            IF (N .LT. 100) GO TO 520                                       S0703630
365*            IF (ISW(2) .EQ. 0) GO TO 540                                    S0703640
366*        C   TOO MANY POINTS. HAVE NOT EVAPORATED DROP YET, MUST MAKE ROOM FOR S0703650
367*        C   MORE POINTS. USE EVERY OTHER POINT FROM 75 TO 100.              S0703660
368*            IF (M .LE. 0) M = 75                                            S0703670
369*            I = M                                                           S0703680
370*            J = M                                                           S0703690
371*          500 I = I+2                                                       S0703700
372*            IF (I .GT. N) GO TO 510                                         S0703710
373*            J = J+1                                                         S0703720
374*            DRPDM(J) = DRPDM(I)                                             S0703730
375*            TMSLO(J) = TMSLO(I)                                             S0703740
376*            HIO(J) = HIO(I)                                                 S0703750
377*            XDO(J) = XDO(I)                                                 S0703760
378*            VSSO(J) = VSSO(I)                                               S0703770
379*            DRPTP(J) = DRPTP(I)                                             S0703780
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380*            DRPBP(J) = DRPBP(I)                                          S0703790
380*            TMASS(J) = TMASS(I)                                          S0703791
381*            TMLSP(J) = TMLSP(I)                                          S0703800
382*            TMSS(J) = TMSS(I)+TMSS(I-1)+TMSS(I-2)                        S0703810
383*            TIMT(J) = TIMT(I)                                            S0703820
384*            GO TO 500                                                    S0703830
385*          510 N = J                                                      S0703840
386*            IF (M .LT. 98) M = M+1                                       S0703850
387*            DELTH = DELTH*2.0                                            S0703860
388*      C     ADJUST DELTH FOR LARGER DECREMENTS IN HEIGHT                 S0703870
389*            IF (ISW(5) .GE. 2) WRITE (IOTFIL,9002) N,M,DELTH             S0703880
390*          520 CONTINUE                                                   S0703890
391*      C     SET PARAMETERS FOR NEXT ITERATION                            S0703900
392*            RD(1) = RDN(1)                                               S0703910
393*            RD(2) = RDN(2)                                               S0703920
394*            RD(3) = RDN(3)                                               S0703930
395*      C     GO TO NEXT ITERATION                                         S0703940
396*            IF (IF1 .EQ. 0) GO TO 150                                    S0703950
397*            HLAST = HI                                                   S0703960
398*            IF1 = 0                                                      S0703970
399*            IF (HI .LT. 0.0) DELTH = DELTH*1.2                           S0703980
400*            DELTAH = DELTH                                               S0703990
401*      C     GO TO NEXT ITERATION                                         S0704000
402*            GO TO 150                                                    S0704010
403*      C     IF NOT ENOUGH POINTS GO CHANGE FCT AND REPEAT ITERATIONS     S0704020
404*          530 IF (N .LT. 50) GO TO 10                                    S0704030
405*          540 CONTINUE                                                   S0704040
406*      C     ITERATIONS COMPLETE                                          S0704050
407*            IF (ISW(5) .LT. 1) GO TO 570                                 S0704060
408*      C     PRINT CALCULATED PARAMETERS                                  S0704070
409*            DO 550 I=1,N                                                 S0704080
410*            CALL IOPUT(2,2,IFUP)                                         S0704090
411*            IF (N .LE. 0) GO TO 560                                      S0704100
412*            WRITE (IOTFIL,9003) HIO(I),DRPTP(I),DRPDM(I),DRPBP(I),TMASS(I),  S0704110
413*           *TMLSP(I),TMSS(I),TIMT(I),XDO(I),VSSO(I),TMSLO(I)             S0704120
414*          550 CONTINUE                                                   S0704130
415*            GO TO 570                                                    S0704140
416*          560 WRITE (IOTFIL,9004)                                        S0704150
417*          570 CONTINUE                                                   S0704160
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418*            N = N-1                                                          S0704170
419*            IF (N .LE. 0) GO TO 590                                          S0704180
420*      C     THE FIRST AND LAST POINTS OF EACH PARAMETER ARRAY ARE REMOVED    S0704190
421*            DO 580 I=1,N                                                     S0704200
422*            DRPDM(I) = DRPDM(I+1)                                            S0704210
423*            TMSLO(I) = TMSLO(I+1)*0.01                                       S0704220
424*            HIO(I) = HIO(I+1)                                                S0704230
425*            XDO(I) = XDO(I+1)                                                S0704240
426*            VSSO(I) = VSSO(I+1)                                              S0704250
427*            TIMT(I) = TIMT(I+1)                                              S0704260
428*        580 CONTINUE                                                         S0704270
429*            N = N-1                                                          S0704280
430*        590 CONTINUE                                                         S0704290
431*            IF (IFUP .EQ. 2) GO TO 620                                       S0704300
432*      C     CALCULATE THE EQUATIONS DESCRIBING THE EVAPORATION VIA REGRESSION S0704310
433*      C     FOR ABOVE CANOPY PARAMETERS.                                     S0704320
434*            IF (N .LE. 0) GO TO 600                                          S0704330
435*      C     CALCULATE THE COEFFICIENTS OF VSSO VERSUS DISTANCE               S0704340
436*            CALL REGRS(N,XDO,VSSO,A1(K),B1(K),C1(K),ISW(2))                  S0704350
437*      C     CALCULATE THE COEFFICIENTS OF HEIGHT VERSUS DISTANCE             S0704360
438*            CALL REGRS(N,XDO,HIO,A2(K),B2(K),C2(K),ISW(2))                   S0704370
439*      C     CALCULATE THE COEFFICIENTS OF HEIGHT VERSUS FRACTION OF DROPS    S0704380
440*            CALL REGRS(N,HIO,TMSLO,A3(K),B3(K),C3(K),ISW(2))                 S0704390
441*      C     CALCULATE THE COEFFICIENTS OF TIME VERSUS HEIGHT                 S0704400
442*            CALL REGRS(N,HIO,TIMT,A4(K),B4(K),C4(K),ISW(2))                  S0704410
443*        600 IF (ISW(5) .LT. 1) GO TO 610                                     S0704420
444*      C     CALC COEFFICIENTS OF DROP VS. TIME EQUATION                      S0704430
445*            CALL REGRS(N,TIMT,DRPDM,T15,T16,T17,ISW(2))                      S0704440
446*            LINE = 57                                                        S0704450
447*            CALL IOPUT(3,2,IFUP)                                             S0704460
448*            WRITE (IOTFIL,9005) A1(K),B1(K),C1(K),A2(K),B2(K),C2(K),         S0704470
449*           *A3(K),B3(K),C3(K),A4(K),B4(K),C4(K),T15,T16,T17                  S0704480
450*      C     SET UPPER AND LOWER DROP SIZES FOR BELOW CANOPY CALCS.           S0704490
451*        610 DRPLWR(K) = DRPBOL                                               S0704500
452*            DRPUPR(K) = DRPTOL                                               S0704510
453*            IF (ISW(5) .LT. 2) GO TO 650                                     S0704520
454*      C     DETAIL OF ACCURACY OF REGRESSION                                 S0704530
455*            CALL TEST(TIMT)                                                  S0704540
456*            GO TO 650                                                        S0704550
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C       BELOW CANOPY EQUATIONS                                                  S0704560
  620 CONTINUE                                                                  S0704570
      IF (N .LE. 0) GO TO 640                                                   S0704580
      HI = XDO(1)                                                               S0704590
      HLAST = 1.0/TMSLO(1)                                                      S0704600
      DO 630 I=1,N                                                              S0704610
      XDO(I) = XDO(I)-HI                                                        S0704620
  630 TMSLO(I) = TMSLO(I)*HLAST                                                 S0704630
C     CALC. COEFFICIENTS OF VSSO VERSUS HEIGHT                                  S0704640
      CALL REGRS(N,HIO,VSSO,A10(K),B10(K),C10(K),ISW(2))                        S0704650
C     CALC. COEFFICIENTS OF HEIGHT VERSUS DISTANCE                              S0704660
      CALL REGRS(N,XDO,HIO,A11(K),B11(K),C11(K),ISW(2))                         S0704670
C     CALC. COEFFICIENTS OF DISTANCE VERSUS HEIGHT                              S0704680
      CALL REGRS(N,HIO,XDO,A12(K),B12(K),C12(K),ISW(2))                         S0704690
C     CALC. COEFFICIENTS OF HEIGHT VERSUS FRACTION OF DROPS                     S0704700
      CALL REGRS(N,HIO,TMSLO,A13(K),B13(K),C13(K),ISW(2))                       S0704710
C     CALC. COEFFICIENTS HEIGHT VERSUS DROP SIZE                                S0704720
      CALL REGRS(N,HIO,DRPDM,A14(K),B14(K),C14(K),ISW(2))                       S0704730
  640 IF (ISW(5) .LT. 1) GO TO 650                                              S0704740
C CALC COEFFICIENTS OF DROP SIZE VS. TIME                                       S0704750
      CALL REGRS(N,TIMT,DRPDM,T15,T16,T17,ISW(2))                               S0704760
      LINE = 57                                                                 S0704770
      CALL IOPUT(3,2,IFUP)                                                      S0704780
      WRITE (IOTFIL,9006) A10(K),B10(K),C10(K),A11(K),B11(K),C11(K),            S0704790
     *A12(K),B12(K),C12(K),A13(K),B13(K),C13(K),A14(K),B14(K),C14(K),           S0704800
     *T15,T16,T17                                                               S0704810
      IF (ISW(5) .LT. 2) GO TO 650                                              S0704820
      CALL TEST(TIMT)                                                           S0704830
  650 CONTINUE                                                                  S0704840
  660 CONTINUE                                                                  S0704850
      RETURN                                                                    S0704860
 9001 FORMAT (A1,15HBEGIN EVAP LOOP,I3,17H FCT,IFUP,HGTCFT=,E14.8,I4,E14S0704870
     *.8)                                                                       S0704880
 9002 FORMAT (26H TOO MANY PNTS, N,M,DELTH=,2I6,E14.8)                          S0704890
 9003 FORMAT (12X,F10.2,3F9.3,3E11.4,F9.3,F9.2,F10.5,F9.2)                      S0704900
 9004 FORMAT (51X,28H* NO DATA, DROP EVAPORATED *)                              S0704910
 9005 FORMAT (44X,43HSETTLING VELOCITY AS A FUNCTION OF DISTANCE/               S0704920
     *33X,10HVS(MPS) = ,E14.8,3H + ,E14.8,5H *X+ ,E14.8,6H *X**2//              S0704930
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457*      C      BELOW CANOPY EQUATIONS                                                S0704560
458*        620 CONTINUE                                                                S0704570
459*            IF (N .LE. 0) GO TO 640                                                 S0704580
460*            HI = XDO(1)                                                             S0704590
461*            HLAST = 1.0/TMSLO(1)                                                    S0704600
462*            DO 630 I=1,N                                                            S0704610
463*            XDO(I) = XDO(I)-HI                                                      S0704620
464*        630 TMSLO(I) = TMSLO(I)*HLAST                                               S0704630
465*      C     CALC. COEFFICIENTS OF VSSO VERSUS HEIGHT                                S0704640
466*            CALL REGRS(N,HIO,VSSO,A10(K),B10(K),C10(K),ISW(2))                      S0704650
467*      C     CALC. COEFFICIENTS OF HEIGHT VERSUS DISTANCE                            S0704660
468*            CALL REGRS(N,XDO,HIO,A11(K),B11(K),C11(K),ISW(2))                       S0704670
469*      C     CALC. COEFFICIENTS OF DISTANCE VERSUS HEIGHT                            S0704680
470*            CALL REGRS(N,HIO,XDO,A12(K),B12(K),C12(K),ISW(2))                       S0704690
471*      C     CALC. COEFFICIENTS OF HEIGHT VERSUS FRACTION OF DROPS                   S0704700
472*            CALL REGRS(N,HIO,TMSLO,A13(K),B13(K),C13(K),ISW(2))                     S0704710
473*      C     CALC. COEFFICIENTS HEIGHT VERSUS DROP SIZE                              S0704720
474*            CALL REGRS(N,HIO,DRPDM,A14(K),B14(K),C14(K),ISW(2))                     S0704730
475*        640 IF (ISW(5) .LT. 1) GO TO 650                                            S0704740
476*      C CALC COEFFICIENTS OF DROP SIZE VS. TIME                                     S0704750
477*            CALL REGRS(N,TIMT,DRPDM,T15,T16,T17,ISW(2))                             S0704760
478*            LINE = 57                                                               S0704770
479*            CALL IOPUT(3,2,IFUP)                                                    S0704780
480*            WRITE (IOTFIL,9006) A10(K),B10(K),C10(K),A11(K),B11(K),C11(K),          S0704790
481*           *A12(K),B12(K),C12(K),A13(K),B13(K),C13(K),A14(K),B14(K),C14(K),         S0704800
482*           *T15,T16,T17                                                             S0704810
483*            IF (ISW(5) .LT. 2) GO TO 650                                            S0704820
484*            CALL TEST(TIMT)                                                         S0704830
485*        650 CONTINUE                                                                S0704840
486*        660 CONTINUE                                                                S0704850
487*            RETURN                                                                  S0704860
488*       9001 FORMAT (A1,15HBEGIN EVAP LOOP,I3,17H FCT,IFUP,HGTCFT=,E14.8,I4,E14S0704870
489*           *.8)                                                                     S0704880
490*       9002 FORMAT (26H TOO MANY PNTS, N,M,DELTH=,2I6,E14.8)                        S0704890
491*       9003 FORMAT (14X,F11.3,1X,3F9.3,2E11.4,F9.3,F9.2,F10.7,F9.3)                 S0704900
492*       9004 FORMAT (51X,28H* NO DATA, DROP EVAPORATED *)                            S0704910
493*       9005 FORMAT (44X,43HSETTLING VELOCITY AS A FUNCTION OF DISTANCE/             S0704920
494*           *33X,10HVS(MPS) = ,E14.8,3H + ,E14.8,5H *X+ ,E14.8,6H *X**2//            S0704930
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495*          *50X,32HHEIGHT AS A FUNCTION OF DISTANCE/                                  S0704940
496*          *34X,7HH(M) = ,E14.8,3H + ,E14.8,5H *X+ ,E14.8,6H *X**2//                  S0704950
497*          *34X,64HFRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HS0704960
498*          *EIGHT/                                                                    S0704970
499*          *34X,8HFRACT = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//                 S0704980
500*          *52X,28HTIME AS A FUNCTION OF HEIGHT/                                      S0704990
501*          *32X,12HTIME(SEC) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//            S0705000
502*          *48X,35HDROP DIAMETER AS A FUNCTION OF TIME/                               S0705010
503*          *25X,16HDROP(MICRO-M) = ,E14.8,3H + ,E14.8,5H *T+ ,E14.8,6H *T**2)         S0705020
504*        9006 FORMAT (45X,41HSETTLING VELOCITY AS A FUNCTION OF HEIGHT/               S0705030
505*          *32X,10HVS(MPS) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//              S0705040
506*          *50X,32HHEIGHT AS A FUNCTION OF DISTANCE/                                  S0705050
507*          *34X,7HH(M) = ,E14.8,3H + ,E14.8,5H *X+ ,E14.8,6H *X**2//                  S0705060
508*          *50X,32HDISTANCE AS A FUNCTION OF HEIGHT/                                  S0705070
509*          *33X,7HX(M) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//                  S0705080
510*          *34X,64HFRACTION OF MATERIAL REACHING H AS DROPS AS A FUNCTION OF HS0705090
511*          *EIGHT/                                                                    S0705100
512*          *34X,8HFRACT = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//                 S0705110
513*          *47X,37HDROP DIAMETER AS A FUNCTION OF HEIGHT/                             S0705120
514*          *30X,15HDROP(MICROM) = ,E14.8,3H + ,E14.8,5H *H+ ,E14.8,6H *H**2//         S0705130
515*          *48X,35HDROP DIAMETER AS A FUNCTION OF TIME/                               S0705140
516*          *30X,15HDROP(MICROM) = ,E14.8,3H + ,E14.8,5H *T+ ,E14.8,6H *T**2)          S0705150
517*           END                                                                       S0705160
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      SUBROUTINE TRMVL                                                  S0800010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S0800020
     *ISW(20),I,J,K,L,M,N,NVS                                           S0800030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S0800040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S0800050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S0800060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S0800070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S0800080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S0800090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S0800100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S0800110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S0800120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S0800130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TRFDEN(3),       S0800140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S0800150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S0800160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S0800170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S0800180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S0800190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S0800200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S0800210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S0800220
      INTEGER TITLE                                                     S0800230
C     CALCULATE THE TERMINAL VELOCITY OF THE UPPER, LOWER AND AVERAGE   S0800240
C     DROP SIZE                                                         S0800250
      DO 40 I=1,3                                                       S0800260
      T15 = RDN(I)*RDN(I)                                               S0800270
      T14 = T2*RDN(I)*T15                                               S0800280
      IF (T14 .GT. 24.0) GO TO 10                                       S0800290
      VSI(I) = T3*T15                                                   S0800300
      GO TO 40                                                          S0800310
   10 IF (T14 .LE. 1.64E10) GO TO 20                                    S0800320
      WRITE (IOTFIL,9001) K                                             S0800330
      STOP                                                              S0800340
C     GO TO 40                                                          S0800350
   20 L = 0                                                             S0800360
   30 L = L+1                                                           S0800370
      IF (T14 .GT. R(L+23)) GO TO 30                                    S0800380
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39*           VSI(I) = T4*(R(L)*(T14/R(L+22))**(ALOG(R(L+1)/R(L))/ALOG(R(L+23)/ S0800390
40*          *R(L+22))))/RDN(I)                                                  S0800400
41*        40 CONTINUE                                                           S0800410
42*           RETURN                                                             S0800420
43*      9001 FORMAT (67H *** WARNING - UNABLE TO CALC. TERMINAL VELOCITY FOR DRS0800430
44*          *OP CATEGORY ,I2)                                                  S0800440
45*           END                                                                S0800450
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      SUBROUTINE REGRS(N,X,Y,A,B,C,ISW2)                                S0900010
C     LEAST SQUARES 2ND ORDER POLYNOMIAL FIT                            S0900020
C     Y = A+B*X+C*X**2                                                  S0900030
      DIMENSION X(1),Y(1)                                               S0900040
      DOUBLE PRECISION SX,SXSQ,SXQB,SXFR,SY,SYX,SYXSQ,XSQ,XQB,XFR,F1,F2,S0900050
     *F3,F4,F5,XPX,XMX,XMXI,XP,YP,YMX,YMXI                              S0900060
      IF (N .LE. 1) GO TO 80                                            S0900070
      XMX = 0.0                                                         S0900080
      YMX = 0.0                                                         S0900090
      DO 10 I=1,N                                                       S0900100
      IF (ABS(X(I)) .GT. XMX) XMX = ABS(X(I))                           S0900110
      IF (ABS(Y(I)) .GT. YMX) YMX = ABS(Y(I))                           S0900120
   10 CONTINUE                                                          S0900130
      IF (XMX) 20,80,20                                                 S0900140
   20 IF (YMX) 30,80,30                                                 S0900150
   30 XMXI = 1.0/XMX                                                    S0900160
      YMXI = 1.0/YMX                                                    S0900170
      SX = 0.0                                                          S0900180
      SXSQ = 0.0                                                        S0900190
      SXQB = 0.0                                                        S0900200
      SXFR = 0.0                                                        S0900210
      SY = 0.0                                                          S0900220
      SYX = 0.0                                                         S0900230
      SYXSQ = 0.0                                                       S0900240
      DO 40 I=1,N                                                       S0900250
      XP = X(I)*XMXI                                                    S0900260
      YP = Y(I)*YMXI                                                    S0900270
      XSQ = XP*XP                                                       S0900280
      XQB = XSQ*XP                                                      S0900290
      XFR = XQB*XP                                                      S0900300
      SX = SX+XP                                                        S0900310
      SXSQ = SXSQ+XSQ                                                   S0900320
      SXQB = SXQB+XQB                                                   S0900330
      SXFR = SXFR+XFR                                                   S0900340
      SY = SY+YP                                                        S0900350
      SYX = SYX+XP*YP                                                   S0900360
      SYXSQ = SYXSQ+YP*XSQ                                              S0900370
   40 CONTINUE                                                          S0900380
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39*           IF (ISW2 .EQ. 0.OR.N .LE. 2) GO TO 60                                                  S0900390
40*           F1 = SXSQ*SXFR-SXQB*SXQB                                                               S0900400
41*           F2 = SX*SXFR-SXQB*SXSQ                                                                 S0900410
42*           F3 = SX*SXSQ-N*SXQB                                                                    S0900420
43*           F4 = SXSQ*SXSQ                                                                         S0900430
44*           F5 = SX*SXQB-F4                                                                        S0900440
45*           XPX = N*F1-SX*F2+SXSQ*F5                                                               S0900450
46*           IF (XPX) 50,60,50                                                                      S0900460
47*        50 XPX = YMX/XPX                                                                          S0900470
48*           F1 = F1*SY                                                                             S0900480
49*           A = (F1-SYX*F2+SYXSQ*F5)*XPX                                                           S0900490
50*           B = (-SY*F2+SYX*(N*SXFR-F4)+SYXSQ*F3)*XPX*XMXI                                         S0900500
51*           C = (SY*F5+SYX*F3+SYXSQ*(N*SXSQ-SX*SX))*XPX*XMXI*XMXI                                  S0900510
52*           GO TO 90                                                                               S0900520
53*        60 XPX = N*SXSQ-SX*SX                                                                     S0900530
54*           IF (XPX) 70,80,70                                                                      S0900540
55*        70 XPX = YMX/XPX                                                                          S0900550
56*           A = (SXSQ*SY-SX*SYX)*XPX                                                               S0900560
57*           B = (-SX*SY+N*SYX)*XPX*XMXI                                                            S0900570
58*           C = 0.0                                                                                S0900580
59*           GO TO 90                                                                               S0900590
60*        80 A = Y(1)                                                                               S0900600
61*           B = 0.0                                                                                S0900610
62*           C = 0.0                                                                                S0900620
63*        90 RETURN                                                                                 S0900630
64*           END                                                                                    S0900640
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1*            FUNCTION AVGRD(A,B)                                                S1000010
2*      C     CALCULATE GEOMETRIC MEAN SIZE                                      S1000020
3*            IF (A-B) 10,20,10                                                  S1000030
4*         10 AVGRD = (2.5E-5*(A*(1.0E4*A*(A+B)+B*(1.0+1.0E4*B))+B*B*B*1.0E4))**S1000040
5*           *.33333333                                                         S1000050
6*            GO TO 30                                                          S1000060
7*         20 AVGRD = A                                                         S1000070
8*         30 RETURN                                                            S1000080
9*            END                                                               S1000090
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      SUBROUTINE IOPUT(IO,JO,KO)                                        S1100010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1100020
     *ISW(20),I,J,K,L,M,N,NVS                                           S1100030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1100040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1100050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),    S1100060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),    S1100070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),    S1100080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1       S1100090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)              S1100100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S1100110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S1100120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S1100130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),       S1100140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S1100150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S1100160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S1100170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S1100180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S1100190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S1100200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S1100210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S1100220
      INTEGER TITLE                                                     S1100230
C     SUBROUTINE TO PRINT HEADINGS FOR EVAPORATION AND CANOPY           S1100240
C     PENETRATION MODEL AND INPUT DATA.                                 S1100250
      IF (IO .EQ. 1) GO TO 10                                           S1100260
      LINE = LINE+1                                                     S1100270
      IF (LINE .LT. 57) GO TO 100                                       S1100280
   10 LINE = 3                                                          S1100290
      IPAGE = IPAGE+1                                                   S1100300
      WRITE (IOTFIL,9001) (TITLE(I1),I1=1,20),IDATE,IPAGE               S1100310
      IF (IO .EQ. 1) GO TO 20                                           S1100320
      WRITE (IOTFIL,9002) ITABLE                                        S1100330
      GO TO 30                                                          S1100340
   20 ITABLE = ITABLE+1                                                 S1100350
      WRITE (IOTFIL,9003) ITABLE                                        S1100360
   30 GO TO (40,50,90,50,100,100),JO                                    S1100370
   40 T15 = -1.0E15                                                     S1100380
```

```
      WRITE (IOTFIL,9004) T15                                                  S1100390
      LINE = LINE+3                                                            S1100400
      GO TO 100                                                                S1100410
   50 IF (KO .EQ. 2) GO TO 60                                                  S1100420
      WRITE (IOTFIL,9005)                                                      S1100430
      GO TO 70                                                                 S1100440
   60 WRITE (IOTFIL,9006)                                                      S1100450
   70 LINE = LINE+3                                                            S1100460
      IF (IO .NE. 2) GO TO 80                                                  S1100470
      WRITE (IOTFIL,9007) K,DRPLWR(K),DRPUPR(K)                                S1100480
      LINE = LINE+8                                                            S1100490
      GO TO 100                                                                S1100500
   80 IF (IO .NE. 3) GO TO 100                                                 S1100510
      WRITE (IOTFIL,9008) K,DRPLWR(K),DRPUPR(K)                                S1100520
      LINE = LINE+3                                                            S1100530
      GO TO 100                                                                S1100540
   90 WRITE (IOTFIL,9009)                                                      S1100550
      LINE = LINE+2                                                            S1100560
  100 RETURN                                                                   S1100570
 9001 FORMAT (24H1FOREST SPRAY MODEL *** ,20A4,10H *** DATE ,2(I2,1H/),       S1100580
     *I2,7H, PAGE ,I3/)                                                        S1100590
 9002 FORMAT (58X,6HTABLE ,I2,8H (CONT.))                                     S1100600
 9003 FORMAT (62X,6HTABLE ,I2)                                                S1100610
 9004 FORMAT (1H0,54X,22H- PROGRAM INPUT DATA -/47X,9H(NOTE - ,F7.5,22H       S1100620
     *MEANS NOT APPLICABLE)/)                                                  S1100630
 9005 FORMAT (1H0,42X,47H- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -S1100640
     */)                                                                      S1100650
 9006 FORMAT (1H0,42X,47H- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -S1100660
     */)                                                                      S1100670
 9007 FORMAT (23X,51H- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY S1100680
     *,I2,2H (,F8.3,3H - ,F8.3,11H MICRO-M) -//16X,4HDROP,10X,13HDROP DIS1100690
     *AMETER,10X,5HTOTAL,6X,16HMASS LOST DUE TO,6X,33HFALL  ALONGWIND SES1100700
     *TTLING  PERCENT/15X,43HHEIGHT   MAXIMUM  AVERAGE  MINIMUM     MASSS1100710
     *,8X,11HEVAPORATION,9X,34HTIME   DISTANCE VELOCITY  MATERIAL/14X,9HS1100720
     *(METERS) ,3(9H(MICRO-M)),70H  (GRAMS)     TOTAL       IN DH     (SES1100730
     *C)   (METERS)   (M/S)   REACHING/59X,2(4X,7H(GRAMS)),32X,6HHEIGHT/S1100740
     *14X,53(2H--))                                                           S1100741
 9008 FORMAT (26X,46H- CALCULATED EQUATIONS FOR DROP SIZE CATEGORY ,I2,2S1100750
     *H (,F8.3,3H - ,F8.3,11H MICRO-M) -//)                                   S1100760
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     39*           WRITE (IOTFIL,9004) T15                                                  S1100390
     40*           LINE = LINE+3                                                            S1100400
     41*           GO TO 100                                                                S1100410
     42*        50 IF (KO .EQ. 2) GO TO 60                                                  S1100420
     43*           WRITE (IOTFIL,9005)                                                      S1100430
     44*           GO TO 70                                                                 S1100440
     45*        60 WRITE (IOTFIL,9006)                                                      S1100450
     46*        70 LINE = LINE+3                                                            S1100460
     47*           IF (IO .NE. 2) GO TO 80                                                  S1100470
     48*           WRITE (IOTFIL,9007) K,DRPLWR(K),DRPUPR(K)                                S1100480
     49*           LINE = LINE+8                                                            S1100490
     50*           GO TO 100                                                                S1100500
     51*        80 IF (IO .NE. 3) GO TO 100                                                 S1100510
     52*           WRITE (IOTFIL,9008) K,DRPLWR(K),DRPUPR(K)                                S1100520
     53*           LINE = LINE+3                                                            S1100530
     54*           GO TO 100                                                                S1100540
     55*        90 WRITE (IOTFIL,9009)                                                      S1100550
     56*           LINE = LINE+2                                                            S1100560
     57*       100 RETURN                                                                   S1100570
     58*      9001 FORMAT (24H1FOREST SPRAY MODEL *** ,20A4,10H *** DATE ,2(I2,1H/),       S1100580
     59*          *I2,7H, PAGE ,I3/)                                                       S1100590
     60*      9002 FORMAT (58X,6HTABLE ,I2,8H (CONT.))                                     S1100600
     61*      9003 FORMAT (62X,6HTABLE ,I2)                                                S1100610
     62*      9004 FORMAT (1HO,54X,22H- PROGRAM INPUT DATA -/47X,8H(NOTE - ,F7.5,22H       S1100620
     63*          *MEANS NOT APPLICABLE)/)                                                 S1100630
     64*      9005 FORMAT (1HO,42X,47H- ABOVE CANOPY EVAPORATION MODEL CALCULATIONS -      S1100640
     65*          */)                                                                      S1100650
     66*      9006 FORMAT (1HO,42X,47H- BELOW CANOPY EVAPORATION MODEL CALCULATIONS -      S1100660
     67*          */)                                                                      S1100670
     68*      9007 FORMAT (23X,51H- DETAIL OF DROP TRAJECTORY FOR DROP SIZE CATEGORY       S1100680
     69*          *,I2,2H (,F8.3,3H - ,F8.3,11H MICRO-M) -//17X,7H   DROP,10X,13HDROP      S1100690
     70*          * DIAMETER,10X,16HMASS LOST DUE TO,6X,33HFALL  ALONGWIND SETTLING        S1100700
     71*          *PERCENT/17X,36H  HEIGHT   MAXIMUM  AVERAGE  MINIMUM,6X,11HEVAPORAT     S1100710
     72*          *ION,9X,34HTIME   DISTANCE VELOCITY  MATERIAL/17X,10H (METERS) ,3(9     S1100720
     73*          *H(MICRO-M)),8H   TOTAL,6X,45HIN DH     (SEC)   (METERS)   (M/S)      S1100730
     74*          *REACHING/56X,18H(GRAMS)    (GRAMS),32X,6HHEIGHT/18X,47(2H--),1H-)       S1100740
     75*      9008 FORMAT (26X,46H- CALCULATED EQUATIONS FOR DROP SIZE CATEGORY ,I2,2      S1100750
     76*          *H (,F8.3,3H - ,F8.3,11H MICRO-M) -//)                                   S1100760
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1*              FUNCTION UNRAN(Z)                                                       S1200010
2*      C       UNIFORM PSUEDO-RANDOM NUMBER GENERATOR BY THE MIXED MULTIPLICITIVES1200020
3*      C       CONGRUENTIAL METHOD.                                                    S1200030
4*              DOUBLE PRECISION A1,A,X,XM,B,C                                          S1200040
5*              DATA X,A,XM/5.66387D5,1.027D3,1.048576D6/                               S1200050
6*              A1 = A*X                                                                S1200060
7*              B = A1/XM                                                               S1200070
8*              C = B*1.0E-4                                                            S1200080
9*              J = C                                                                   S1200090
10*             C = FLOAT(J)*1.0E4                                                      S1200100
11*             J = B-C                                                                 S1200110
12*             B = C+FLOAT(J)                                                          S1200120
13*             X = A1-B*XM                                                             S1200130
14*             Z = X/XM                                                                S1200140
15*             UNRAN = Z                                                               S1200150
16*             RETURN                                                                  S1200160
17*             END                                                                     S1200170
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      SUBROUTINE CANPY                                                  S1300010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1300020
     *ISW(20),I,J,K,L,M,N,NVS                                           S1300030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1300040
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1300050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1300060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),   S1300070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),   S1300080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1      S1300090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)             S1300100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,   S1300110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,          S1300120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),         S1300130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TRFDEN(3),       S1300140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),      S1300150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,       S1300160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,    S1300170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),    S1300180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),      S1300190
     *TMLSO(20),RDST(20),XLOCS(20),                                     S1300200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),  S1300210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                       S1300220
      DIMENSION RTMX(3),SPCT(3),HWRAT(3),SPCTI(3),ELTDI(20)             S1300230
      EQUIVALENCE (RTMX(1),RDST(1)),(SPCT(1),RDST(4)),(HWRAT(1),RDST(7))S1300240
     *,(SPCTI(1),RDST(10)),(ELTDI(1),XLOCS(1))                          S1300250
      INTEGER TITLE                                                     S1300260
C     THIS SUBROUTINE CALCULATES THE PERCENT OF MATERIAL OF EACH DROP   S1300270
C     SIZE CATEGORY THAT REACHES A GIVEN HEIGHT IN THE FOREST CANOPY.   S1300280
C     ALSO, THE HORIZONTAL DISTANCE FROM WHERE A DROP ENTERS THE CANOPY S1300290
C     TO THE POINT OF IMPACTION IS CALCULATED. THE METHOD IS A MONTE    S1300300
C     CARLO TECHNIQUE.                                                  S1300310
C                                                                       S1300320
C                                                                       S1300330
C                                                                       S1300340
      DO 20 I=1,20                                                      S1300350
      ELTDI(I) = 0.0                                                    S1300360
      DO 10 J=1,11                                                      S1300370
      DISTM(J,I) = 0.0                                                  S1300380
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39*          10 CNTD(J,I) = 0.0                                                    S1300390
40*             IF (I .GT. 3) GO TO 20                                             S1300400
41*             RTMX(I) = 0.0                                                      S1300410
42*             SPCT(I) = 0.0                                                      S1300420
43*             HWRAT(I) = 0.0                                                     S1300430
44*             SPCTI(I) = 0.0                                                     S1300440
45*          20 CONTINUE                                                           S1300450
46*       C     DIVIDE THE TALLEST CLASS OF TREES INTO TENTHS                      S1300460
47*             V1 = HGTCAN(1)*0.1                                                 S1300470
48*       C     DETERMINE NUMBER OF DROP SIZE CATEGORIES REACHING CANOPY           S1300480
49*             NVSS = 0                                                           S1300490
50*             DO 30 I=1,20                                                       S1300500
51*             IF (DRPUPR(I) .LE. 0.0) GO TO 40                                   S1300510
52*             NVSS = NVSS+1                                                      S1300520
53*          30 CONTINUE                                                           S1300530
54*          40 CONTINUE                                                           S1300540
55*             IF (NVSS .EQ. 0) GO TO 380                                         S1300550
56*       C     CALCULATE THE NUMBER OF TREE HEIGHT CATEGORIES                     S1300560
57*             NT = 1                                                             S1300570
58*             IF (HGTCAN(2) .GT. 0.0) NT = NT+1                                  S1300580
59*             IF (HGTCAN(3) .GT. 0.0) NT = NT+1                                  S1300590
60*       C     CHANGE TREE ENVELOPE TO RADIUS, SAVING THE MAXIMUM                 S1300600
61*             L = 0                                                              S1300610
62*             DO 60 I=1,NT                                                       S1300620
63*             RTMX(I) = 0.0                                                      S1300630
64*             K = HGTCAN(I)                                                      S1300640
65*             DO 50 J =1,K                                                       S1300650
66*             TREENV(J+L) = TREENV(J+L)*0.5                                      S1300660
67*       C     MAXIMUM TREE RADIUS                                                S1300670
68*             IF (TREENV(J+L) .GT. RTMX(I)) RTMX(I) = TREENV(J+L)                S1300680
69*          50 CONTINUE                                                           S1300690
70*          60 L = L+K                                                            S1300700
71*             DO 70 I=1,NT                                                       S1300710
72*       C     CALCULATE THE SPACING BETWEEN TREES FOR EACH TREE HEIGHT CLASS     S1300720
73*             SPCT(I) = 63.614907/SQRT(TREDEN(I))                                S1300730
74*       C     CALCULATE THE RATIO OF TREE HEIGHT TO MAXIMUM WIDTH                S1300740
75*             HWRAT(I) = HGTCAN(I)/(2.0*RTMX(I))                                 S1300750
76*       C     INVERSE OF TREE SPACING                                            S1300760
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77*                SPCTI(I) = 1.0/SPCT(I)                                          S1300770
78*          C     INVERSE OF ELEMENT SIZE FOR EACH CLASS OF TREES                 S1300780
79*                ELTDI(I) = 1.0/ABS(COLEFF(I))                                   S1300790
80*             70 CONTINUE                                                        S1300800
81*          C                                                                     S1300810
82*                IF (COLEFF(1) .GE. 0.0) GO TO 80                                S1300820
83*          C     NEG. COLEFF INDICATES ELEMENT SIZE, MUST CALCULATE THE COLLECTION S1300830
84*          C     EFFICIENCY                                                      S1300840
85*                Z1 = 0.25*HGTCAN(1)                                             S1300850
86*                Z2 = 0.5*HGTCAN(1)                                              S1300860
87*                Z3 = 0.75*HGTCAN(1)                                             S1300870
88*             80 CONTINUE                                                        S1300880
89*                IF (ISW(3) .GE. 3) WRITE (IOTFIL,9001) NVSS,NT,V1,RTMX,SPCT,HWRAT,S1300890
90*               *(ELTDI(I),I=1,3),Z1,Z2,Z3                                       S1300900
91*          C  90                                                                 S1300910
92*          C     BEGIN MAJOR LOOP OVER DROP SIZE CATEGORIES                      S1300920
93*                DO 370 L=1,NVSS                                                 S1300930
94*                IF (ABS(A14(L))+ABS(B14(L)) .LE. 0.0) GO TO 370                 S1300940
95*          C     CALCULATE HORIZONTAL DISTANCE FROM DROP ENTRY POINT IN CANOPY TO S1300950
96*          C     TRAJECTORY INTERSECTION AT EACH TENTH OF THE CANOPY HEIGHT      S1300960
97*                ZP = HGTCAN(1)+V1                                               S1300970
98*                DO 100 I=1,11                                                   S1300980
99*                ZP = ZP-V1                                                      S1300990
100*            100 DISTM(12-I,L) = B12(L)*(ZP-HGTCAN(1))+C12(L)*(ZP*ZP-HGTCAN(1)*HGTCS1301000
101*               *AN(1))                                                        S1301010
102*         C     THE TOTAL NUMBER OF DROPS IN THE DISTRIBUTION IS NDRS           S1301020
103*               NDRPS = 500                                                     S1301030
104*         C     INVERSE OF NDRPS                                                S1301040
105*               XNDRPS = 1.0/NDRPS                                              S1301050
106*         C     BEGIN MAJOR LOOP OVER THE NUMBER OF DROPS IN THE DISTRIBUTION   S1301060
107*               IF (ISW(3) .GE. 3) WRITE (IOTFIL,9002) L,NDRPS                  S1301070
108*         C 110                                                                 S1301080
109*               DO 350 K=1,NDRPS                                                S1301090
110*         C     SET DEPTH OF PENETRATION EQUAL TO ZERO                          S1301100
111*               HPEN = 0.0                                                      S1301110
112*               L1 = 0                                                          S1301120
113*         C     BEGIN MAJOR LOOP OVER TREE HEIGHT CLASSES                       S1301130
114*               DO 330 J=1,NT                                                   S1301140
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      SPCTI(I) = 1.0/SPCT(I)                                                S1300770
C     INVERSE OF ELEMENT SIZE FOR EACH CLASS OF TREES                       S1300780
      ELTDI(I) = 1.0/ABS(COLEFF(I))                                         S1300790
   70 CONTINUE                                                              S1300800
C                                                                           S1300810
      IF (COLEFF(1) .GE. 0.0) GO TO 80                                      S1300820
C     NEG. COLEFF INDICATES ELEMENT SIZE, MUST CALCULATE THE COLLECTION     S1300830
C     EFFICIENCY                                                            S1300840
      Z1 = 0.25*HGTCAN(1)                                                   S1300850
      Z2 = 0.5*HGTCAN(1)                                                    S1300860
      Z3 = 0.75*HGTCAN(1)                                                   S1300870
   80 CONTINUE                                                              S1300880
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9001) NYSS,NT,V1,RTMX,SPCT,HWRAT,S1300890
     *(ELTDI(I),I=1,3),Z1,Z2,Z3                                             S1300900
C  90                                                                       S1300910
C     BEGIN MAJOR LOOP OVER DROP SIZE CATEGORIES                            S1300920
      DO 370 L=1,NYSS                                                       S1300930
      IF (ABS(A14(L))+ABS(B14(L)) .LE. 0.0) GO TO 370                       S1300940
C     CALCULATE HORIZONTAL DISTANCE FROM DROP ENTRY POINT IN CANOPY TO      S1300950
C     TRAJECTORY INTERSECTION AT EACH TENTH OF THE CANOPY HEIGHT            S1300960
      ZP = HGTCAN(1)+V1                                                     S1300970
      DO 100 I=1,11                                                         S1300980
      ZP = ZP-V1                                                            S1300990
  100 DISTM(12-I,L) = B12(L)*(ZP-HGTCAN(1))+C12(L)*(ZP*ZP-HGTCAN(1)*HGTCS1301000
     *AN(1))                                                                S1301010
C     THE TOTAL NUMBER OF DROPS IN THE DISTRIBUTION IS NDRS                 S1301020
      NDRPS = 500                                                           S1301030
C     INVERSE OF NDRPS                                                      S1301040
      XNDRPS = 1.0/NDRPS                                                    S1301050
C     BEGIN MAJOR LOOP OVER THE NUMBER OF DROPS IN THE DISTRIBUTION         S1301060
      IF (ISW(3) .GE. 3) WRITE (IOTFIL,9002) L,NDRPS                        S1301070
C 110                                                                       S1301080
      DO 350 K=1,NDRPS                                                      S1301090
C     SET DEPTH OF PENETRATION EQUAL TO ZERO                                S1301100
      HPEN = HGTCAN(1)                                                      S1301110
      L1 = 0                                                                S1301120
C     BEGIN MAJOR LOOP OVER TREE HEIGHT CLASSES                             S1301130
      DO 330 J=1,NT                                                         S1301140
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115*      C      CALCULATE THE NUMBER OF TREES IN THE DROP TRAJECTORY PATH          S1301150
116*             NTREE = DISTM(1,L)*SPCTI(J)+1                                      S1301160
117*             IF (NTREE .LT. 2) NTREE = 2                                        S1301170
118*             IF (NTREE .GT. 1000) NTREE = 1000                                  S1301180
119*      C      BEGIN LOOP OVER THE NUMBER OF TREES                                S1301190
120*             IF (ISW(3) .GE. 3) WRITE (IOTFIL,9003) K,J,NTREE                   S1301200
121*      C 120                                                                     S1301210
122*             DO 280 I=1,NTREE                                                   S1301220
123*      C      CALCULATE THE DISTANCE TO THIS TREE                                S1301230
124*             XP = (NTREE-I)*SPCT(J)                                             S1301240
125*      C      CALCULATE RANDOM NUMBER                                            S1301250
126*             V2 = UNRAN(V3)                                                     S1301260
127*      C      RANDOMLY DISTRIBUTE TREES ALONG TRAJECTORY PATH                    S1301270
128*             XP = XP+SPCT(J)*(V2-0.5)                                           S1301280
129*      C      RANDOMLY DISTRIBUTE TREES ACROSS TRAJECTORY PATH                   S1301290
130*             V2= UNRAN(V3)                                                      S1301300
131*             YP = SPCT(J)*ABS(V2-0.5)                                           S1301310
132*             IF (ISW(3) .GE. 3) WRITE (IOTFIL,9004) I,XP,YP,V2                  S1301320
133*      C 130                                                                     S1301330
134*             IF (I .LT. NTREE) GO TO 170                                        S1301340
135*      C      LOOP OVER TENTHS OF THE TREE HEIGHT TO CHECK FOR DROP IMPACTION    S1301350
136*             IF (XP .LE. -RTMX(J)) GO TO 280                                    S1301360
137*             MH = HGTCAN(J)                                                     S1301370
138*             ZP = MH+1                                                          S1301380
139*      C      LOOP OVER 1 METER HEIGHT LEVELS OF FOREST FROM TOP TO BOTTOM       S1301390
140*             DO 160 M=1,MH                                                      S1301400
141*             ZP = ZP-1.0                                                        S1301410
142*      C      CALCULATE DROP SIZE TO SEE IF VAPOR                                S1301420
143*             DI = A14(L)+ZP*(B14(L)+ZP*C14(L))                                  S1301430
144*             IF (ISW(3) .GE. 3) WRITE (IOTFIL,9005) M,ZP,DI                     S1301440
145*      C 140                                                                     S1301450
146*             IF (DI .LT. 5.0) GO TO 300                                         S1301460
147*      C      CALCULATE DISTANCE FROM POINT DROP TRAJECTORY HITS GROUND          S1301470
148*      C      UPWIND TO HEIGHT ZT ON TRAJECTORY                                  S1301480
149*             XR = ZP*(-B12(L)-C12(L)*ZP)                                        S1301490
150*      C      CALCULATE LATERAL DISTANCE TO TREE                                 S1301500
151*             YR = SQRT((XP-XR)**2+YP*YP)                                        S1301510
152*      C      IF THE RADIUS OF THE TREE IS GREATER THAN YR, THEN POSSIBLE HIT    S1301520
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153*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9006) XR,YR,TREENV(MH-M+1+L1)    S1301530
154*      C 150                                                                    S1301540
155*            IF (TREENV(MH-M+1+L1) .GT. YR) GO TO 200                           S1301550
156*      C     DROP MISSES TREE                                                   S1301560
157*        160 CONTINUE                                                           S1301570
158*            GO TO 290                                                          S1301580
159*        170 CONTINUE                                                           S1301590
160*      C     LOOP OVER TREES ALONG THE TRAJECTORY PATH                          S1301600
161*      C     CALCULATE THE HEIGHT OF THE TRAJECTORY AT DISTANCE XP              S1301610
162*            ZP = A12(L)-XP                                                     S1301620
163*            ZP = A11(L)+ZP*(B11(L)+C11(L)*ZP)                                  S1301630
164*            IF (ZP .GT. HGTCAN(J)) ZP = HGTCAN(J)                              S1301640
165*            IF (ZP .LT. 0.0) ZP = 0.0                                          S1301650
166*      C     CALCULATE DROP SIZE TO SEE IF VAPOR                                S1301660
167*            DI = A14(L)+ZP*(B14(L)+ZP*C14(L))                                  S1301670
168*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9007) ZP,DI                       S1301680
169*      C 180                                                                    S1301690
170*            IF (DI .LT. 5.0) GO TO 300                                         S1301700
171*      C     CALCULATE THE RADIUS OF THE TREE AT ZP                             S1301710
172*            I1 = ZP                                                            S1301720
173*            RT = I1+1                                                          S1301730
174*            RT = TREENV(I1+1)-(TREENV(I1+1)-TREENV(I1))*(RT-ZP)                S1301740
175*      C     IF THE RADIUS OF THE TREE IS GREATER THAN YP, THEN POSSIBLE HIT    S1301750
176*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9008) RT,YP                       S1301760
177*      C 190                                                                    S1301770
178*            IF (RT .LE. ABS(YP)) GO TO 280                                     S1301780
179*      C     POSSIBLE IMPACTION, DETERMINE PROBABILITY OF IMPACTION             S1301790
180*      C     CALCULATE PATH LENGTH FACTOR XR                                    S1301800
181*        200 XR = XP+RT                                                         S1301810
182*            YR = A11(L)+XR*(B11(L)+C11(L)*XR)                                  S1301820
183*            XR = ZP-YR                                                         S1301830
184*            XR = SQRT(XR*XR+RT*RT)/RT                                          S1301840
185*            IF (XR .GT. HWRAT(J)) XR = HWRAT(J)                                S1301850
186*            IF (COLEFF(1) .GE. 0.0) GO TO 250                                  S1301860
187*      C     MUST CALCULATE THE COLLECTION EFFICIENCY                           S1301870
188*      C     CALCULATE DROP DIAMETER AT ZP                                      S1301880
189*            DI = A14(L)+ZP*(B14(L)+C14(L)*ZP)                                  S1301890
190*      C     CALCULATE DROP IMPACTION VELOCITY                                  S1301900
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153*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9006) XR,YR,TREENV(MH-M+1+L1)    S1301530
154*      C 150                                                                    S1301540
154*            RT = TREENV(MH-M+1+L1)                                             S1301540
155*            IF (TREENV(MH-M+1+L1) .GT. YR) GO TO 200                           S1301550
156*      C     DROP MISSES TREE                                                   S1301560
157*        160 CONTINUE                                                           S1301570
158*            GO TO 290                                                          S1301580
159*        170 CONTINUE                                                           S1301590
160*      C     LOOP OVER TREES ALONG THE TRAJECTORY PATH                          S1301600
161*      C     CALCULATE THE HEIGHT OF THE TRAJECTORY AT DISTANCE XP              S1301610
162*            ZP = A12(L)-XP                                                     S1301620
163*            ZP = A11(L)+ZP*(B11(L)+C11(L)*ZP)                                  S1301630
164*            IF (ZP .GT. HGTCAN(J)) ZP = HGTCAN(J)                              S1301640
165*            IF (ZP .LT. 0.0) ZP = 0.0                                          S1301650
166*      C     CALCULATE DROP SIZE TO SEE IF VAPOR                                S1301660
167*            DI = A14(L)+ZP*(B14(L)+ZP*C14(L))                                  S1301670
168*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9007) ZP,DI                       S1301680
169*      C 180                                                                    S1301690
170*            IF (DI .LT. 5.0) GO TO 300                                         S1301700
171*      C     CALCULATE THE RADIUS OF THE TREE AT ZP                             S1301710
172*            I1 = ZP                                                            S1301720
173*            RT = I1+1                                                          S1301730
174*            RT = TREENV(I1+1+L1)-(TREENV(I1+1+L1)-TREENV(I1+L1))*(RT-ZP)       S1301740
175*      C     IF THE RADIUS OF THE TREE IS GREATER THAN YP, THEN POSSIBLE HIT    S1301750
176*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9008) RT,YP                       S1301760
177*      C 190                                                                    S1301770
178*            IF (RT .LE. ABS(YP)) GO TO 280                                     S1301780
179*      C     POSSIBLE IMPACTION, DETERMINE PROBABILITY OF IMPACTION             S1301790
180*      C     CALCULATE PATH LENGTH FACTOR XR                                    S1301800
181*        200 XR = XP+RT                                                         S1301810
182*            YR = A11(L)+XR*(B11(L)+C11(L)*XR)                                  S1301820
183*            XR = ZP-YR                                                         S1301830
183*            XRS = 0.0                                                          S1301831
184*            IF (RT .GT. 0.0) XRS= SQRT(XR*XR+RT*RT)/RT                         S1301840
184*            XR = XRS                                                           S1301841
185*            IF (XR .GT. HWRAT(J)) XR = HWRAT(J)                                S1301850
186*            IF (COLEFF(1) .GE. 0.0) GO TO 250                                  S1301860
187*      C     MUST CALCULATE THE COLLECTION EFFICIENCY                           S1301870
188*      C     CALCULATE DROP DIAMETER AT ZP                                      S1301880
189*            DI = A14(L)+ZP*(B14(L)+C14(L)*ZP)                                  S1301890
190*      C     CALCULATE DROP IMPACTION VELOCITY                                  S1301900
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191*            VI = A10(L)+ZP*(B10(L)+C10(L)*ZP)                                S1301910
192*            IF (ZP .LE. Z1) GO TO 230                                        S1301920
193*            IF (ZP .LE. Z2) GO TO 220                                        S1301930
194*            IF (ZP .LE. Z3) GO TO 210                                        S1301940
195*            U = WSIN44                                                       S1301950
196*            GO TO 240                                                        S1301960
197*          210 U = WSIN34                                                     S1301970
198*            GO TO 240                                                        S1301980
199*          220 U = WSIN24                                                     S1301990
200*            GO TO 240                                                        S1302000
201*          230 U = WSIN14                                                     S1302010
202*          240 U = SQRT(U*U+VI*VI)                                            S1302020
203*        C     CALCULATE THE COLLECTION EFFICIENCY                            S1302030
204*            U = 2.8E-4*DI*DI*U*ELTDI(J)                                      S1302040
205*            GO TO 260                                                        S1302050
206*          250 U = COLEFF(L)                                                  S1302060
207*          260 CONTINUE                                                       S1302070
208*            IF (U .GT. 1.0) U = 1.0                                          S1302080
209*        C     CALCULATE THE PROBABILITY                                      S1302090
210*            PR = (1.0-PRBPEN(J)**XR)*U                                       S1302100
211*        C     CALCULATE RANDOM NUMBER                                        S1302110
212*            V2 = UNRAN(V3)                                                   S1302120
213*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9009) XR,YR,DI,VI,U             S1302130
214*           *,ZP,PR,V2                                                        S1302140
215*        C 270                                                               S1302150
216*            IF (V2 .LE. PR) GO TO 300                                        S1302160
217*        C     END LOOP OVER TREES                                            S1302170
218*          280 CONTINUE                                                       S1302180
219*        C     DROP IMPACTS ON GROUND                                         S1302190
220*          290 ZP = HGTCAN(1)                                                 S1302200
221*            GO TO 310                                                        S1302210
222*        C     DROP IMPACTS AT HEIGHT ZP                                      S1302220
223*          300 ZP = HGTCAN(1)-ZP                                              S1302230
224*        C     SAVE MINIMUM PENETRATION OF DROP OVER MULTI-STORIED CANOPIES   S1302240
225*          310 IF (ZP .LT. HPEN) HPEN = ZP                                    S1302250
226*        C     END OF LOOP OVER TREE HEIGHT CLASSES                           S1302260
227*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9010) ZP,HPEN                   S1302270
228*        C 320                                                               S1302280
```

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191*            VI = A10(L)+ZP*(B10(L)+C10(L)*ZP)                          S1301910
192*            IF (ZP .LE. Z1) GO TO 230                                  S1301920
193*            IF (ZP .LE. Z2) GO TO 220                                  S1301930
194*            IF (ZP .LE. Z3) GO TO 210                                  S1301940
195*            U = WSIN44                                                 S1301950
196*            GO TO 240                                                  S1301960
197*          210 U = WSIN34                                               S1301970
198*            GO TO 240                                                  S1301980
199*          220 U = WSIN24                                               S1301990
200*            GO TO 240                                                  S1302000
201*          230 U = WSIN14                                               S1302010
202*          240 U = SQRT(U*U+VI*VI)                                      S1302020
203*        C     CALCULATE THE COLLECTION EFFICIENCY                      S1302030
204*            U = 2.8E-4*DI*DI*U*ELTDI(J)                                S1302040
205*            GO TO 260                                                  S1302050
206*          250 U = COLEFF(L)                                            S1302060
207*          260 CONTINUE                                                 S1302070
208*            IF (U .GT. 1.0) U = 1.0                                    S1302080
209*        C     CALCULATE THE PROBABILITY                                S1302090
210*            PR = (1.0-PRBPEN(J)**XR)*U                                 S1302100
211*        C     CALCULATE RANDOM NUMBER                                  S1302110
212*            V2 = UNRAN(V3)                                             S1302120
213*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9009) XR,YR,DI,VI,U       S1302130
214*           *,ZP,PR,V2                                                  S1302140
215*        C 270                                                          S1302150
216*            IF (V2 .LE. PR) GO TO 300                                  S1302160
217*        C     END LOOP OVER TREES                                      S1302170
218*          280 CONTINUE                                                 S1302180
219*        C     DROP IMPACTS ON GROUND                                   S1302190
220*          290 ZP = HGTCAN(1)                                           S1302200
221*            GO TO 310                                                  S1302210
222*        C     DROP IMPACTS AT HEIGHT ZP                                S1302220
223*          300 ZP = HGTCAN(1)-ZP                                        S1302230
224*        C     SAVE MAXIMUM PENETRATION OF DROP THROUGH CANOPY          S1302240
225*          310 IF (ZP .GT. HPEN) HPEN = ZP                              S1302250
226*        C     END OF LOOP OVER TREE HEIGHT CLASSES                     S1302260
227*            IF (ISW(3) .GE. 3) WRITE (IOTFIL,9010) ZP,HPEN             S1302270
228*        C 320                                                          S1302280
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229*        330 L1 = L1+HGTCAN(J)                                                  S1302290
230*      C     SUM THE NUMBER OF DROPS PASSING THE GIVEN HEIGHTS IN CANOPY       S1302300
231*            XP = 0.0                                                          S1302310
232*            DO 340 J=1,11                                                     S1302320
233*            IF (HPEN+.001 .LT. XP) GO TO 350                                  S1302330
234*            XP = XP+V1                                                        S1302340
235*        340 CNTD(12-J,L) = CNTD(12-J,L)+1.0                                   S1302350
236*      C     END LOOP OVER DROPS IN DISTRIBUTION                               S1302360
237*        350 CONTINUE                                                          S1302370
238*      C     CALCULATE FRACTION OF MATERIAL THAT REACHES EACH TENTH OF HEIGHT  S1302380
239*            DO 360 I=1,11                                                     S1302390
240*      C                                                                       S1302400
241*        360 CNTD(I,L) = CNTD(I,L)*XNDRPS                                      S1302410
242*        370 CONTINUE                                                          S1302420
243*        380 CONTINUE                                                          S1302430
244*            IF (ISW(3) .LT. 2) GO TO 420                                      S1302440
245*            CALL IOPUT(1,3,0)                                                 S1302450
246*            ZP = HGTCAN(1)+V1                                                 S1302460
247*            DO 390 I=1,11                                                     S1302470
248*            ZP = ZP-V1                                                        S1302480
249*        390 SPCT(I) = ZP                                                      S1302490
250*            IF (SPCT(11) .LT. 0.0) SPCT(11) = 0.0                             S1302500
251*            WRITE (IOTFIL,9011) (SPCT(I),I=1,6)                               S1302510
252*            DO 400 I=1,NVS                                                    S1302520
253*        400 WRITE (IOTFIL,9012) I,(CNTD(12-J,I),DISTM(12-J,I),J=1,6)          S1302530
254*            WRITE (IOTFIL,9013) (SPCT(I),I=7,11)                              S1302540
255*            DO 410 I=1,NVS                                                    S1302550
256*        410 WRITE (IOTFIL,9012) I,(CNTD(12-J,I),DISTM(12-J,I),J=7,11)         S1302560
257*            LINE = 57                                                         S1302570
258*        420 RETURN                                                            S1302580
259*       9001 FORMAT (8H11 NVSS=,I2,4H NT=,I1,4H V1=,F5.2,6H RTMX=,3F8.5,6H SPCTS1302590
260*           *=,3F8.4/7H HWRAT=,3F8.3,7H ELTDI=,3F8.4,10H Z1,Z2,Z3=,3F8.4)      S1302600
261*       9002 FORMAT (26H 2 LOOP OVER SIZE CATEGORY,I3,8H, NDRPS=,I4)           S1302610
262*       9003 FORMAT (15H 3 DROP NUMBER=,I4,19H TREE HEIGHT CLASS=,I2,17H NUMBERS1302620
263*           * OF TREES=,I6)                                                    S1302630
264*       9004 FORMAT (15H 4 TREE NUMBER=,I6,3H X=,F10.4,3H Y=,F10.4,9H RAND. #=,S1302640
265*           *E14.8)                                                           S1302650
266*       9005 FORMAT (5H 5 M=,I4,4H ZP=,F8.4,4H DI=,F9.4)                      S1302660
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267*      9006 FORMAT (6H 6 XR=,F10.4,4H YR=,F10.4,8H TREENV=,F10.5)                S1302670
268*      9007 FORMAT (6H 7 ZP=,F10.4,4H DI=,F10.4)                                 S1302680
269*      9008 FORMAT (6H 8 RT=,F10.4,4H YP=,F10.4)                                 S1302690
270*      9009 FORMAT (6H 9 XR=,F10.4,4H YR=,F10.4,4H DI=,F10.4,4H VI=,F10.4,3H US1302700
271*          1=,F10.4,4H ZP=,F10.4,4H PR=,F10.4,4H V2=,F10.4)                      S1302710
272*      9010 FORMAT (7H 10 ZP=,F10.4,6H HPEN=,F10.4)                              S1302720
273*      9011 FORMAT (1HO,3X,4HDROP,15X,55HFRACTION/DISTANCE OF MATERIAL REACHINS1302730
274*          1G INDICATED HEIGHT/3X,7HSIZE  /,6(6H  HGT=,F5.1,5H M  /)/10H CATEGS1302740
275*          2ORY/,6(16H FRACT /DIST(M)/)/1X,52(2H--),1H-)                         S1302750
276*      9012 FORMAT (4X,I2,3X,6(F8.5,F8.1))                                       S1302760
277*      9013 FORMAT (1HO,3X,4HDROP,15X,55HFRACTION/DISTANCE OF MATERIAL REACHINS1302770
278*          1G INDICATED HEIGHT/3X,7HSIZE  /,5(6H  HGT=,F5.1,5H M  /)/10H CATEGS1302780
279*          2ORY/,5(16H FRACT /DIST(M)/)/1X,44(2H--),1H-)                         S1302790
280*           END                                                                  S1302800
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      SUBROUTINE TEST(TIMT)                                                 S1400010
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40),     S1400020
     *ISW(20),I,J,K,L,M,N,NVS                                               S1400030
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),                   S1400040
     *Z,WSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,       S1400050
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),       S1400060
     *A1(20),B1(20),C1(20),A2(20),B2(20),C2(20),A3(20),B3(20),C3(20),       S1400070
     *CNTD(11,20),DISTM(11,20),A4(20),B4(20),C4(20),VSSS(20),A13(20),       S1400080
     *B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA,BETA1          S1400090
     *,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)                 S1400100
      COMMON /COM3/ THERMC,CONMOL,DFUSIV,HETLAT,AIRPRS,VAPINF,BCONST,       S1400110
     *CCONST,DRPPRS,DRPTMP,VAPMOL,ARCRWT,ARCRSP,AIRTPO,AIRDEN,              S1400120
     *AIRTPU,AIRMOL,DENLIQ,RELHMO,RELHMU,DRPUPR(20),DRPLWR(20),             S1400130
     *WSIN14,WSIN24,WSIN34,WSIN44,PRBPEN(3),COLEFF(20),TREDEN(3),           S1400140
     *TREENV(100),DAU(20),DBU(20),DCU(20),DAL(20),DBL(20),DCL(20),          S1400150
     *T1,T2,T3,T4,T5,T6,T7,T8,T9,T10,T11,T12,T13,T14,T15,T16,T17,           S1400160
     *R(44),RD(3),RN(2),FV(2),VSI(3),RDN(3),IF1,IF2,IF3,IF4,IF5,IF6,       S1400170
     *XLOC,TIME,TMLST,HI,HLAST,DRPTO,DRPTOL,DRPBO,DRPBOL,TMSLO(100),        S1400180
     *HIO(100),XDO(100),VSSO(100),DRPDM(100),IFUP,IFWATR,TIMO(20),          S1400190
     *TMLSO(20),RDST(20),XLOCS(20),                                         S1400200
     *A10(20),B10(20),C10(20),A11(20),B11(20),C11(20),A12(20),B12(20),      S1400210
     *C12(20),A14(20),B14(20),C14(20),DUMMY(1080)                           S1400220
      DIMENSION TIMT(1)                                                     S1400230
      INTEGER TITLE                                                         S1400240
C     THIS SUBROUTINE PRINTS THE ACTUAL VALUE VERSUS THE VALUE              S1400250
C     CALCULATED VIA THE EQUATIONS DETERMINED BY REGRESSION FOR ABOVE       S1400260
C     AND BELOW CANOPY EVAPORATION. THE COLUMN TITLED ERROR IS THE          S1400270
C     PERCENTAGE INCREASE OR DECREASE BETWEEN THE PREDICTED TO ACTUAL       S1400280
C     VALUE - ERROR = 100.0*(1.0-PREDICTED/ACTUAL)                          S1400290
C                                                                           S1400300
      IF (IFUP .EQ. 2) GO TO 70                                             S1400310
      WRITE (IOTFIL,9001)                                                   S1400320
      DO 60 I=1,N                                                           S1400330
      VSP = A1(K)+XDO(I)*(B1(K)+XDO(I)*C1(K))                               S1400340
      HGT = A2(K)+XDO(I)*(B2(K)+XDO(I)*C2(K))                               S1400350
      TMT = A3(K)+HIO(I)*(B3(K)+HIO(I)*C3(K))                               S1400360
      TMT = TMT*100.0                                                       S1400370
      IF (C2(K)) 10,20,10                                                   S1400380
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39*          10 CONTINUE                                                          S1400390
40*             XPP = B2(K)*B2(K)-4.0*(A2(K)-HIO(I))*C2(K)                        S1400400
41*             IF (XPP .LT. 0.0) XPP = 0.0                                       S1400410
42*             XDTP = (-B2(K)-SQRT(XPP))/(2.0*C2(K))                             S1400420
43*             GO TO 50                                                          S1400430
44*          20 IF (B2(K)) 30,40,30                                               S1400440
45*          30 XDTP = (HIO(I)-A2(K))/B2(K)                                       S1400450
46*             GO TO 50                                                          S1400460
47*          40 XDTP = 0.0                                                        S1400470
48*          50 CONTINUE                                                          S1400480
49*             TM = A4(K)+HIO(I)*(B4(K)+HIO(I)*C4(K))                            S1400490
50*             CALL TESS(W1,HGT,HIO(I))                                          S1400500
51*             CALL TESS(W2,XDTP,XDO(I))                                         S1400510
52*             CALL TESS(W3,VSP,VSSO(I))                                         S1400520
53*             CALL TESS(W5,TM,TIMT(I))                                          S1400530
54*             W1 = 100.0*(W1-1.0)                                               S1400540
55*             W2 = 100.0*(W2-1.0)                                               S1400550
56*             W3 = 100.0*(W3-1.0)                                               S1400560
57*             W5 = 100.0*(W5-1.0)                                               S1400570
58*             TMPP = TMSLO(I)*100.0                                             S1400580
59*             CALL TESS(W4,TMT,TMPP)                                            S1400590
60*             W4 = 100.0*(W4-1.0)                                               S1400600
61*             WRITE (IOTFIL,9002) HIO(I),HGT,W1,XDO(I),XDTP,W2,VSSO(I),VSP,W3,  S1400610
62*           1TMPP,TMT,W4,TIMT(I),TM,W5                                          S1400620
63*          60 CONTINUE                                                          S1400630
64*             GO TO 190                                                         S1400640
65*          70 WRITE (IOTFIL,9003)                                               S1400650
66*             DO 180 I=1,N                                                      S1400660
67*             VSP = A10(K)+HIO(I)*(B10(K)+HIO(I)*C10(K))                        S1400670
68*             HGT = A11(K)+XDO(I)*(B11(K)+XDO(I)*C11(K))                        S1400680
69*             XDT = A12(K)+HIO(I)*(B12(K)+HIO(I)*C12(K))                        S1400690
70*             TMT = A13(K)+HIO(I)*(B13(K)+HIO(I)*C13(K))                        S1400700
71*             TMT = TMT*100.0                                                   S1400710
72*             DRT = A14(K)+HIO(I)*(B14(K)+HIO(I)*C14(K))                        S1400720
73*             IF (C11(K)) 80,90,80                                              S1400730
74*          80 CONTINUE                                                          S1400740
75*             XPP = B11(K)*B11(K)-4.0*(A11(K)-HIO(I))*C11(K)                    S1400750
76*             IF (XPP .LT. 0.0) XPP = 0.0                                       S1400760
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      XDTP = (-B11(K)-SQRT(XPP))/(2.0*C11(K))                                   S1400770
      GO TO 120                                                                 S1400780
   90 IF (B11(K)) 100,110,100                                                   S1400790
  100 XDTP = (HIO(I)-A11(K))/B11(K)                                             S1400800
      GO TO 120                                                                 S1400810
  110 XDTP = 0.0                                                                S1400820
  120 IF (C12(K)) 130,140,130                                                   S1400830
  130 CONTINUE                                                                  S1400840
      XPP = B12(K)*B12(K)-4.0*(A12(K)-XDO(I))*C12(K)                            S1400850
      IF (XPP .LT. 0.0) XPP = 0.0                                               S1400860
      HGTP = (-B12(K)-SQRT(XPP))/(2.0*C12(K))                                   S1400870
      GO TO 170                                                                 S1400880
  140 IF (B12(K)) 150,160,150                                                   S1400890
  150 HGTP = (XDO(I)-A12(K))/B12(K)                                             S1400900
      GO TO 170                                                                 S1400910
  160 HGTP = 0.0                                                                S1400920
  170 CONTINUE                                                                  S1400930
      CALL TESS(W1,HGT,HIO(I))                                                  S1400940
      CALL TESS(W2,XDTP,XDO(I))                                                 S1400950
      CALL TESS(W3,VSP,VSSO(I))                                                 S1400960
      W1 = 100.0*(W1-1.0)                                                       S1400970
      W2 = 100.0*(W2-1.0)                                                       S1400980
      W3 = 100.0*(W3-1.0)                                                       S1400990
      W6 = TMSLO(I)*100.0                                                       S1401000
      CALL TESS(W4,TMT,W6)                                                      S1401010
      CALL TESS(W5,DRT,DRPDM(I))                                                S1401020
      W4 = 100.0*(W4-1.0)                                                       S1401030
      W5 = 100.0*(W5-1.0)                                                       S1401040
      WRITE (IOTFIL,9002) HIO(I),HGT,W1,XDO(I),XDTP,W2,VSSO(I),VSP,W3,          S1401050
     1W6,TMT,W4,DRPDM(I),DRT,W5                                                 S1401060
  180 CONTINUE                                                                  S1401070
  190 RETURN                                                                    S1401080
 9001 FORMAT (1H1,9X,6HHEIGHT,9X,1H/,11X,8HDISTANCE,9X,1H/,9X,2HVS,11X,1S1401090
     *H/,10X,4H%AT,10X,1H/,11X,4HTIME/129H   EXACT  APPROX    ERROR     S1401100
     * EXACT    APPROX    ERROR  EXACT APPROX    ERROR   EXACT  APPROX  S1401110
     *  ERROR    EXACT   APPROX    ERROR/1X,65(2H--)/113H ERROR IS THE PS1401120
     *ERCENT CHANGE OR ERROR = 100.0*(1.0-APPROX/EXACT), WHERE EXACT=EXAS1401130
     *CT VALUE, APPROX=PREDICTED VALUE)                                         S1401140
```

```
115*      9002 FORMAT (2(1X,F7.3),F9.3,2F10.3,F9.3,2F7.4,F9.3,2F8.3,4F9.3)        S1401150
116*      9003 FORMAT (1H1,9X,6HHEIGHT,9X,1H/,11X,8HDISTANCE,9X,1H/,9X,2HVS,11X,1S1401160
117*          *H/,10X,4H%MAT,10X,1H/,11X,4HDROP/129H   EXACT  APPROX    ERROR    S1401170
118*          * EXACT    APPROX    ERROR  EXACT APPROX    ERROR   EXACT  APPROX  S1401180
119*          *  ERROR    EXACT   APPROX    ERROR/1X,65(2H--)/113H ERROR IS THE PS1401190
120*          *ERCENT CHANGE OR ERROR = 100.0*(1.0-APPROX/EXACT), WHERE EXACT=EXAS1401200
121*          *CT VALUE, APPROX=PREDICTED VALUE)                                 S1401210
122*           END                                                               S1401220
```

```
 1*          SUBROUTINE TESS(W,A1,A2)                                  S1500010
 2*          IF (A1) 10,30,10                                          S1500020
 3*       10 IF (A2) 20,60,20                                          S1500030
 4*       20 W = A1/A2                                                 S1500040
 5*          GO TO 70                                                  S1500050
 6*       30 IF (A2) 40,50,40                                          S1500060
 7*       40 W = 0.0                                                   S1500070
 8*          GO TO 70                                                  S1500080
 9*       50 W = 1.0                                                   S1500090
10*          GO TO 70                                                  S1500100
11*       60 W = 1.0E30                                                S1500110
12*       70 RETURN                                                    S1500120
13*          END                                                       S1500130
```

```
 1*            SUBROUTINE CBGS4                                                  S1600010
 2*            DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S1600020
 3*           *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S1600030
 4*           *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4                           S1600040
 5*            COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1600050
 6*           *ISW(20),I,J,K,L,M,N,NVS                                           S1600060
 7*            COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1600070
 8*           *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,  S1600080
 9*           *HM,DX(50),DY(50),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),     S1600090
10*           *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S1600100
11*           *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S1600110
12*           *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA    S1600120
13*           *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S1600130
14*            COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S1600140
15*           *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S1600150
16*           *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S1600160
17*           *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S1600170
18*            DIMENSION ZERO(1)                                                 S1600180
19*            EQUIVALENCE (ZERO(1),CALC(1,1))                                   S1600190
20*            INTEGER TITLE                                                     S1600200
21*      C     THIS ROUTINE IS THE MAIN ROUTINE OF THE DISPERSION MODELS ROUTINES S1600210
22*      C                                                                       S1600220
23*      C                                                                       S1600230
24*      C     SET MODEL CONSTANTS                                               S1600240
25*            DO 10 I=1,2285                                                    S1600250
26*         10 ZERO(I) = 0.0                                                     S1600260
27*      C     RAD IS PI/180                                                     S1600270
28*            RAD = .0174532925200                                              S1600280
29*      C     SQR2 = SQRT(2)                                                    S1600290
30*            SQR2 = 1.414213562                                                S1600300
31*      C     SQRP = SQRT(PI)                                                   S1600310
32*            SQRP = 1.772453851                                                S1600320
33*            IF (SIGAP .GE. 1.0) SIGAP = SIGAP*RAD                             S1600330
34*            IF (SIGEP .GE. 1.0) SIGEP = SIGEP*RAD                             S1600340
35*            IF (TAU-TAUO) 20,30,20                                            S1600350
36*         20 SIGAP = SIGAP*(TAU/TAUO)**0.2                                     S1600360
37*         30 CONTINUE                                                          S1600370
38*            UBARSI = 1.0/WSOCAN                                               S1600380
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      SUBROUTINE CBGS5                                                  S1700010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S1700020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S1700030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,TT7,XP                    S1700040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1700050
     *ISW(20),I,J,K,L,M,N,NVS                                           S1700060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1700070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,  S1700080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1700090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S1700100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S1700110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA     S1700120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S1700130
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S1700140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S1700150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S1700160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S1700170
      DIMENSION XDO(20)                                                 S1700180
      EQUIVALENCE (SIGZI,SNMYP),(SIGZ,SBI),(SIGYI,API),(XY,SNMYPS),     S1700190
     *(SIGZI2,APIP)                                                     S1700200
      INTEGER TITLE                                                     S1700210
      SIGAPR = SIGAP                                                    S1700220
      SIGEPR = SIGEP                                                    S1700230
      IZ = 0                                                            S1700240
      HM = HM-HGTCAN(1)                                                 S1700250
      IF (Z .GE. HGTCAN(1)) GO TO 50                                    S1700260
C     IZ = 0, FOR NO CANOPY OR Z >= HGTCAN(1)                           S1700270
C     IZ = 1, FOR CANOPY WITH Z = 0.0                                   S1700280
C     IZ = I, FOR CANOPY WITH Z > .1*(I-2)*HGTCAN(1) AND Z <= .1*(I-1)* S1700290
C             HGTCAN(1)                                                 S1700300
      IZ = 1                                                            S1700310
      IF (Z .LE. 0.0) GO TO 30                                          S1700320
      DO 10 I=2,11                                                      S1700330
      IF (Z .LE. 0.1*FLOAT(I-1)*HGTCAN(1)) GO TO 20                     S1700340
   10 CONTINUE                                                          S1700350
      I = 11                                                            S1700360
   20 IZ = I                                                            S1700370
C     DETERMINE NUMBER OF DROP SIZE CATEGORIES                          S1700380
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39*          30 NTVS = 0                                                                    S1700390
40*             DO 40 I=1,20                                                                S1700400
41*             IF (VSSS(I) .LE. 0.0) GO TO 50                                              S1700410
42*          40 NTVS = NTVS+1                                                               S1700420
43*          50 CONTINUE                                                                    S1700430
44*             ZP = 0.0                                                                    S1700440
45*             IF (Z .GT. HGTCAN(1)) ZP = Z-HGTCAN(1)                                      S1700450
46*             T3 = 0.5*WNGSPN+HGTCAN(1)                                                   S1700460
47*       C     CALCULATE TIME FOR DROP TRAJECTORY TO REACH HEIGHT WNGSPN/2 ABOVE           S1700470
48*       C     CANOPY (T4) FOR CASES WHERE WAKVEL >= THE DROP SETTLING VELOCITY.           S1700480
49*             T4 = 0.0                                                                    S1700490
50*             IF (WAKVEL .GT. 0.0) T4 = (HGTCFT-T3)/WAKVEL                                S1700500
51*             IF (T4 .LT. 0.0) T4 = 0.0                                                   S1700510
52*       C     CALCULATE PARTS OF THE DISPERSION MODELS                                    S1700520
53*             B1 = SIGXYZ/SIGEPR                                                          S1700530
54*             B3 = Q*3.9894228E-1                                                         S1700540
55*             DELTAH = 1.0                                                                S1700550
56*             TT5 = 1.0/SIGEPR                                                            S1700560
57*             TT6 = BETA1*TT5                                                             S1700570
58*       C     TT8 IS (DELTAH)/SQRT(12)                                                    S1700580
59*             TT8 = DELTAH*2.886751E-1                                                    S1700590
60*             T5 = TT8*TT5                                                                S1700600
61*             XLRZY = XLRZ                                                                S1700610
62*             T6 = 0.5*DELTAH                                                             S1700620
63*             T7 = SIGXYZ/SIGAPR                                                          S1700630
64*             T8 = TT8/SIGAPR                                                             S1700640
65*             SIGX1 = SIGXYZ*SIGXYZ                                                       S1700650
66*             SIGX2 = TT8*TT8                                                             S1700660
67*             TT10 = Q*.15915494                                                          S1700670
68*             A1 = SQR2*SIGAPR                                                            S1700680
69*             A2 = SIGAPR*TT5                                                             S1700690
70*             IF (SIGAPR-SIGEPR) 70,60,70                                                 S1700700
71*          60 A2 = 1.0                                                                    S1700710
72*          70 CONTINUE                                                                    S1700720
73*             A3 = A2*TT10                                                                S1700730
74*             SK = A2                                                                     S1700740
75*             A2 = A2*A2                                                                  S1700750
76*             A6 = 1.0/A1                                                                 S1700760
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 77*            A8 = A6*UBARSI                                                  S1700770
 78*      C     THETAP IS AZIMUTH WIND DIRECTION.                               S1700780
 79*            THETAP = THETA+180.0                                            S1700790
 80*            IF (THETAP .GE. 360.0) THETAP = THETAP-360.0                    S1700800
 81*            K = 0                                                           S1700810
 82*         80 K = K+1                                                         S1700820
 83*      C                                                                     S1700830
 84*      C                                                                     S1700840
 85*      C                                                                     S1700850
 86*      C                                                                     S1700860
 87*      C                                                                     S1700870
 88*      C*********************************************************************S1700880
 89*      C     BEGIN LOOP OVER LINE SOURCES.                                   S1700890
 90*      C                                                                     S1700900
 91*      C                                                                     S1700910
 92*      C                                                                     S1700920
 93*            IF (K .LE. NSOURC) GO TO 100                                    S1700930
 94*      C     GO PRINT DISPERSION MODEL CALCULATIONS                          S1700940
 95*         90 CONTINUE                                                        S1700950
 96*            CALL CBGS6                                                      S1700960
 97*            RETURN                                                          S1700970
 98*        100 L = 2*K-1                                                       S1700980
 99*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) K,DX(L),DY(L),DX(L+1),   S1700990
100*           *DY(L+1)                                                         S1701000
101*      C     TL IS LENGTH OF LINE SOURCES BUT NOT NECESSARILY THE EFFECTIVE   S1701010
102*      C     LENGTH.                                                         S1701020
103*            TL = SQRT((DX(L+1)-DX(L))**2+(DY(L+1)-DY(L))**2)                S1701030
104*      C     GAM IS ANGLE FROM NORTH TO LINE SOURCE.                         S1701040
105*            GAM = ATAN2(DX(L+1)-DX(L),DY(L+1)-DY(L))*57.29577951            S1701050
106*            IF (GAM .LT. 0.0) GAM = GAM+360.0                               S1701060
107*      C     ALPH IS ANGULAR DIFFERENCE OF LINE SOURCE & WIND DIRECTION.     S1701070
108*      C     CHECK TO SEE IF WITHIN 90 DEGREE DIFFERENCE.                    S1701080
109*            ALPH = ABS(THETAP-GAM)                                          S1701090
110*            IF (ALPH .LE. 90.0) GO TO 110                                   S1701100
111*            IF (360.0-ALPH .LE. 90.0) GO TO 110                             S1701110
112*      C     EXCHANGE END POINTS OF LINE SOURCE & ADD 180 DEGREES TO GAM.    S1701120
113*            B6 = DX(L+1)                                                    S1701130
114*            DX(L+1) = DX(L)                                                 S1701140
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115*            DX(L) = B6                                                      S1701150
116*            B6 = DY(L+1)                                                    S1701160
117*            DY(L+1) = DY(L)                                                 S1701170
118*            DY(L) = B6                                                      S1701180
119*            GAM = GAM+180.0                                                 S1701190
120*            IF (GAM .GT. 360.0) GAM = GAM-360.0                             S1701200
121*            ALPH = ABS(THETAP-GAM)                                          S1701210
122*            IF (ALPH .GT. 180.0) ALPH = 360.0-ALPH                          S1701220
123*          110 IF (ALPH .GE. 90.0) ALPH = 360.0-ALPH                         S1701230
124*      C     MODEL = 1 IS LINE SOURCE AND WIND DIRECTION ARE NOT NORMAL NOR   S1701240
125*      C     ARE THEY PARALLEL TO EACH OTHER.                                S1701250
126*            MODEL = 1                                                       S1701260
127*            IF (ALPH .GE. 0.5.AND.ALPH .LE. 89.5) GO TO 120                 S1701270
128*      C     MODEL = 2 IS LINE SOURCE AND WIND DIRECTION ARE NORMAL TO EACH   S1701280
129*      C     OTHER.                                                          S1701290
130*            IF (ALPH .GE. 89.5) MODEL = 2                                   S1701300
131*      C     MODEL = 3 IS LINE SOURCE AND WIND DIRECTION ARE PARALLEL TO EACH S1701310
132*      C     OTHER.                                                          S1701320
133*            IF (ALPH .LE. 0.5) MODEL = 3                                    S1701330
134*          120 GO TO (130,140,130),MODEL                                     S1701340
135*      C     BET IS THE THETA USED IN MODEL EQUATIONS.                       S1701350
136*          130 BET = 90.0-ALPH                                               S1701360
137*            IF (MODEL .EQ. 3) BET = 90.0                                    S1701370
138*            A5 = BET*RAD                                                    S1701380
139*            TSIN = DSIN(A5)                                                 S1701390
140*            TCOS = DCOS(A5)                                                 S1701400
141*            TT1 = TCOS*TCOS                                                 S1701410
142*            TT2 = 0.0                                                       S1701420
143*            IF (MODEL .NE. 3) TT2 = 1.0/(TCOS*TSIN)                         S1701430
144*            TT3 = TCOS/TSIN                                                 S1701440
145*            TT4 = TL*TSIN                                                   S1701450
146*            TT7 = 2.0/TSIN                                                  S1701460
147*            A5 = A6*TT3                                                     S1701470
148*      C     TRIG SIN & COS FOR ROTATION & TRANSLATION OF AXES FROM X,Y TO   S1701480
149*      C     XR,YR MODEL SYSTEM.                                             S1701490
150*            GAM1 = (GAM+180.0)*RAD                                          S1701500
151*            RCOS = COS(GAM1)                                                S1701510
152*            RSIN = SIN(GAM1)                                                S1701520
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153*            A7 = A5*A5                                                      S1701530
154*            SN2 = A3*TT7                                                    S1701540
155*            SN3 = 0.5*SN2/(SK*SIGAPR)                                       S1701550
156*            GO TO 150                                                       S1701560
157*        140 BET = 0.0                                                       S1701570
158*            GAM1 = (GAM+180.0)*RAD                                          S1701580
159*            TSIN = 0.0                                                      S1701590
160*            TCOS = 1.0                                                      S1701600
161*            TT1 = 1.0                                                       S1701610
162*            TT2 = 0.0                                                       S1701620
163*            TT3 = 0.0                                                       S1701630
164*            TT4 = 0.0                                                       S1701640
165*            B6 = THETA*RAD                                                  S1701650
166*            RCOS = COS(B6)                                                  S1701660
167*            RSIN = SIN(B6)                                                  S1701670
168*            T1 = 0.5*(DX(L)+DX(L+1))                                        S1701680
169*            T2 = 0.5*(DY(L)+DY(L+1))                                        S1701690
170*            SN2 = B3                                                        S1701700
171*            SN3 = B3                                                        S1701710
172*            T12 = 0.5*TL                                                    S1701711
173*        150 CONTINUE                                                        S1701720
174*            T9 = 0.5*TSIN                                                   S1701730
175*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9002) MODEL,SIGAPR,SIGEPR,B3,A1, S1701740
176*           *A2,A3,SK,A6,THETAP,B1,TL,GAM,ALPH,BET,TSIN,TCOS,A5,RCOS,RSIN,A7, S1701750
177*           *SN2,SN3,T1,T2                                                   S1701760
178*     C                                                                     S1701770
179*     C                                                                     S1701780
180*     C                                                                     S1701790
181*     C                                                                     S1701800
182*     C                                                                     S1701810
183*     C                                                                     S1701820
184*     C*********************************************************************S1701830
185*     C     BEGIN LOOP OVER RECEPTOR POINTS                                 S1701840
186*     C                                                                     S1701850
187*     C                                                                     S1701860
188*     C                                                                     S1701870
189*     C                                                                     S1701880
190*           M = 1                                                           S1701890
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191*            J = 0                                                                  S1701900
192*      C     LOOP OVER Y RECEPTORS                                                  S1701910
193*        160 J = J+1                                                                S1701920
194*            IF (J .GT. NYPNTS) GO TO 190                                           S1701930
195*            JJ = (J-1)*NXPNTS                                                      S1701940
196*            I = 0                                                                  S1701950
197*      C     LOOP OVER X RECEPTORS                                                  S1701960
198*        170 I = I+1                                                                S1701970
199*            IF (I .GT. NXPNTS) GO TO 160                                           S1701980
200*        180 II = I+JJ                                                              S1701990
201*            GO TO 210                                                              S1702000
202*        190 IF (NXYPNT .LE. 0) GO TO 80                                            S1702010
203*            I = NXPNTS                                                             S1702020
204*            J = NYPNTS                                                             S1702030
205*            JJ = NXPNTS*NYPNTS-NXPNTS                                              S1702040
206*            M = 2                                                                  S1702050
207*      C     LOOP OVER DISCRETE RECEPTORS                                           S1702060
208*        200 I = I+1                                                                S1702070
209*            J = J+1                                                                S1702080
210*            IF (I .GT. NXYPNT+NXPNTS) GO TO 80                                     S1702090
211*            GO TO 180                                                              S1702100
212*        210 CONTINUE                                                               S1702110
213*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9003) I,J,X(I),Y(J),M,JJ,II           S1702120
214*      C     CALC DOWN AND CROSSWIND DIST TO RECEPTOR                               S1702130
215*            IF (MODEL .EQ. 2) GO TO 250                                            S1702140
216*            X1 = X(I)-DX(L)                                                        S1702150
217*            Y1 = Y(J)-DY(L)                                                        S1702160
218*            YRR = -X1*RSIN - Y1*RCOS                                               S1702170
219*            XRR = -X1*RCOS + Y1*RSIN                                               S1702180
220*            IF(ABS(THETAP-GAM) .GT. 180.0) GO TO 230                               S1702190
221*            IF(THETAP .GE. GAM) GO TO 240                                          S1702200
222*        220 XRR = -XRR                                                             S1702210
223*            GO TO 240                                                              S1702220
224*        230 IF(THETAP .GT. GAM) GO TO 220                                          S1702230
225*        240 CONTINUE                                                               S1702240
226*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9004) X1,Y1,XRR,YRR                   S1702250
227*            XR = XRR                                                               S1702260
228*            YR = YRR                                                               S1702270
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229*            XP = XR*TCOS+YR*TSIN                                          S1702280
230*            IF (MODEL .EQ. 3) YP = DABS(XR)                               S1702290
231*            XPP = XP                                                      S1702300
232*            GO TO 260                                                     S1702310
233*      250   X1 = X(I)-T1                                                  S1702320
234*            Y1 = Y(J)-T2                                                  S1702330
235*            XR = -X1*RSIN-Y1*RCOS                                         S1702340
236*            YR =  X1*RCOS-Y1*RSIN                                         S1702350
237*            XP = XR                                                       S1702360
238*            XPP = XR                                                      S1702370
239*            YP = YR                                                       S1702380
240*            T10 = (T12+YP)*.70710678                                      S1702381
241*            T11 = (T12-YP)*.70710678                                      S1702382
242*      260   CONTINUE                                                      S1702390
243*            IF (IZ .EQ. 0.AND.XPP .LE. 0.0) GO TO (170,200),M             S1702400
244*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9005) XR,YR,XP,YP,XPP        S1702410
245*      C                                                                   S1702420
246*      C                                                                   S1702430
247*      C                                                                   S1702440
248*      C                                                                   S1702450
249*      C                                                                   S1702460
250*      C                                                                   S1702470
251*      C*******************************************************************S1702480
252*      C     BEGIN LOOP OVER DROP SIZE CATEGORIES                          S1702490
253*      C                                                                   S1702500
254*      C                                                                   S1702510
255*      C                                                                   S1702520
256*      C                                                                   S1702530
257*            N = 0                                                         S1702540
258*            TSUM1 = 0.0                                                   S1702550
259*            TSUM2 = 0.0                                                   S1702560
260*            TSUM3 = 0.0                                                   S1702570
261*      270   N = N+1                                                       S1702580
262*            IF (N .GT. NVS) GO TO 720                                     S1702590
263*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9006) N,IZ,MODEL             S1702600
264*            IF (IZ .NE. 0.AND.VSSS(N) .LE. 0.0) GO TO 270                 S1702610
265*      C     KT = 1, FOR DROP MODEL CALCULATIONS                           S1702620
266*      C     KT = 2, FOR VAPOR MODEL CALCULATIONS                          S1702630
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267*            KT = 1                                                          S1702640
268*      C     XM IS HORIZONTAL DISTANCE DROP TRAVELS IN CANOPY                S1702650
269*            XM = 0.0                                                        S1702660
270*            IF (IZ .NE. 0) XM = DISTM(IZ,N)                                 S1702670
271*            GO TO 300                                                       S1702680
272*        280 IF (IZ .NE. 0) GO TO 270                                        S1702690
273*            IF (ISW(9) .EQ. 0) GO TO 270                                    S1702700
274*            IF (ISW(6) .EQ. 0.AND.ISW(7) .EQ. 0) GO TO 270                  S1702710
275*            KN = 0                                                          S1702720
276*      C     BEGIN VAPOR MODEL CALCULATIONS                                  S1702730
277*            KT = 2                                                          S1702740
278*            VAP = 0.0                                                       S1702750
279*            H = HGTCFT+T6                                                   S1702760
280*            VS = 0.0                                                        S1702770
281*      C     FOLLOW DROP (VOLUME SOURCE) DOWN IN DECREMENTS OF DELTAH        S1702780
282*      C     WHEN DROP HAS COMPLETELY EVAPORATED THE SWITCH KN IS SET TO 1.  S1702790
283*        290 H = H-DELTAH                                                    S1702800
284*            IF (KN .NE. 0.OR.H .LE. HGTCAN(1)) GO TO 270                    S1702810
285*      C     CALCULATE TIME TO DROP HEIGHT ABOVE CANOPY (VOLUME SOURCE)      S1702820
286*            A4 = AX4(N)+H*(BX4(N)+H*CX4(N))                                 S1702830
286*            IF (A4 .LT. 0.0) GO TO 270                                      S1702831
287*      C     CALCULATE HORIZONTAL DISTANCE TO DROP.                          S1702840
288*            XM = WSOCAN*A4                                                  S1702850
289*        300 CONTINUE                                                        S1702860
290*      C     ADJUST ALONGWIND DISTANCE TO RECEPTOR FOR DISTANCE DROP HAS     S1702870
291*      C     TRAVELED.                                                       S1702880
292*            XPP = XP-XM                                                     S1702890
293*            IF (XPP .LE. 0.0) GO TO 270                                     S1702900
294*            IF (MODEL .EQ. 2) GO TO 310                                     S1702910
295*      C     PARALLEL ALONG THE LINE SOURCE DISTANCE TO RECEPTOR RELATIVE TO S1702920
296*      C     UPWIND END OF LINE SOURCE.                                      S1702930
297*            YR = YRR-XM*TSIN                                                S1702940
298*      C     NORMAL ACROSS THE LINE SOURCE DISTANCE TO THE RECEPTOR.         S1702950
299*            XR = XRR-XM*TCOS                                                S1702960
300*        310 CONTINUE                                                        S1702970
301*            SL = 0.0                                                        S1702980
302*      C     CALCULATE THE EFFECTIVE LENGTH OF THE LINE SOURCE               S1702990
303*            IF (MODEL .NE. 2) SL = YR+XR*TT3                                S1703000
304*            IF (SL .GT. TL) SL = -TL                                        S1703010
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305*      C      CALCULATE THE EFFECTIVE ALONGWIND DISTANCE FROM LINE SOURCE TO    S1703020
306*      C      RECEPTOR.                                                         S1703030
307*             XBAR = XPP-ABS(SL)*T9                                             S1703040
308*             IF (ISW(4) .GE. 2) WRITE (IOTFIL,9007) XM,XPP,XP,YP,XR,YR,XBAR,T10S1703120
309*            *,T11,SL                                                          S1703130
310*      C                                                                       S1703140
311*      C                                                                       S1703150
312*      C      CALC. TIME TO STABILIZATION.                                     S1703160
313*      C                                                                       S1703170
314*      C      INITIAL DROP SETTLING VELOCITY AT AIRCRAFT ALTITUDE (VSP)        S1703180
315*             VSP = AX1(N)                                                      S1703190
316*             IF (WAKVEL .GE. VSP) GO TO 330                                    S1703200
317*      C      CALC. TIME TO HEIGHT WNGSPN/2 ABOVE CANOPY FROM TIME VS. HEIGHT   S1703210
318*      C      FUNCTION FOR ABOVE CANOPY DROPS.                                 S1703220
319*             TIME = AX4(N)+T3*(BX4(N)+T3*CX4(N))                               S1703230
320*             GO TO 340                                                         S1703240
321*        330  TIME = T4                                                        S1703250
322*        340  CONTINUE                                                        S1703260
323*             IF (ISW(4) .GE. 2) WRITE (IOTFIL,9008) VSP,T3,TIME               S1703270
323*             IF (TIME .LT. 0.0) GO TO (280,290),KT                            S1703271
324*             IF (KT .EQ. 2) GO TO 400                                          S1703280
325*      C      CALC. VS AT HEIGHT WNGSPN 2 ABOVE CANOPY                         S1703290
326*             IF (CX2(N)) 350,360,350                                           S1703300
327*      C      FIRST CALC. DISTANCE (B55) TO HEIGHT.                            S1703310
328*        350  B5 = BX2(N)*BX2(N)-4.0*(AX2(N)-T3)*CX2(N)                        S1703320
329*             IF (B5 .LT. 0.0) B5 = 0.0                                         S1703330
330*             B55 = (-BX2(N)-SQRT(B5))/(2.0*CX2(N))                             S1703340
331*             GO TO 390                                                         S1703350
332*        360  IF (BX2(N)) 370,380,370                                          S1703360
333*        370  B55 = (T3-AX2(N))/BX2(N)                                         S1703370
334*             GO TO 390                                                         S1703380
335*        380  B55 = 0.0                                                        S1703390
336*      C      CALC. VS AT HEIGHT T3 FROM ABOVE CANOPY EQUATION.                S1703400
337*        390  VSP = AX1(N)+B55*(BX1(N)+B55*CX1(N))                             S1703410
338*      C                                                                       S1703420
339*      C      CALC. EFFECTIVE RELEASE HEIGHT                                   S1703430
340*      C                                                                       S1703440
341*             H = T3+TIME*VSP                                                   S1703450
342*             IF (ISW(4) .GE. 2) WRITE (IOTFIL,9009) B5,B55,VSP,H               S1703460
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342*            IF (VSP .LT. 0.0) GO TO (280,290),KT                                S1703461
343*      C                                                                         S1703470
344*      C                                                                         S1703480
345*        400 CONTINUE                                                            S1703490
346*      C                                                                         S1703500
347*            FRACT = 1.0                                                         S1703510
348*            XEF = XBAR                                                          S1703520
349*            IF (KT .EQ. 2) GO TO 590                                            S1703730
350*            IF (IZ .NE. 0) GO TO 440                                            S1703740
351*      C     CALC. EFFECTIVE VS FOR ABOVE CANOPY Z.                              S1703750
352*            VS = AX1(N)+XEF*(BX1(N)+XEF*CX1(N))                                 S1703760
353*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9011) VS                           S1703770
353*            IF (VS .LE. 0.0) GO TO (280,290),KT                                 S1703771
354*            GO TO 590                                                           S1703780
355*      C                                                                         S1703790
356*      C     CALC. EFFECTIVE VS FOR BELOW CANOPY Z.                              S1703900
357*        440 DO 450 IG=1,NTVS                                                    S1703910
358*        450 XDO(IG) = XP-DISTM(IZ,IG)-ABS(SL)*T9                                S1703920
359*      C     CALC. EQUATION OF VS OVER SIZE CATEGORIES AS A FUNCTION OF          S1703930
360*      C     DISTANCE FROM SOURCE TO POINT DROP TRAJECTORY ENTERS CANOPY.        S1703940
361*            CALL REGRS(NTVS,XDO,VSSS,AT,BT,CT,1)                                S1703950
362*      C     SOLVE FOR THE INTERSECTION OF CURVE GIVEN BY AT, BT AND CT WITH     S1703960
363*      C     THE CURVE OF VS VERSUS DISTANCE FOR DROP CATEGORY N.                S1703970
364*      C     0 = (AT-AX1(N))+(BT-BX1(N))*X+(CT-CX1(N))*X**2                      S1703980
365*      C                                                                         S1703990
366*            X1 = 1.0                                                            S1703991
367*            IF (CT-CX1(N)) 460,470,460                                          S1704000
368*      C     QUADRATIC                                                           S1704001
369*        460 B5 = (BT-BX1(N))**2-4.0*(AT-AX1(N))*(CT-CX1(N))                     S1704010
370*            IF (B5 .LT. 0.0) B5 = 0.0                                           S1704020
371*      C     DISTANCE TO INTERSECTION (XEF) OF TWO CURVES                        S1704030
372*            XEF = (-(BT-BX1(N))-SQRT(B5))/(2.0*(CT-CX1(N)))                     S1704040
373*            X1 = 0.0                                                            S1704050
374*            IF (XEF .GT. 0.0) GO TO 505                                         S1704051
375*        465 XEF = (-(BT-BX1(N))+SQRT(B5))/(2.0*(CT-CX1(N)))                     S1704052
376*            X1 = 1.0                                                            S1704053
377*            GO TO 500                                                           S1704060
378*      C     LINEAR                                                              S1704061
379*        470 IF (BT-BX1(N)) 480,490,480                                          S1704070
380*      C     DISTANCE TO INTERSECTION (XEF) OF TWO CURVES.                       S1704080
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381*        480 XEF = -(AT-AX1(N))/(BT-BX1(N))                                S1703990
382*            IF (XEF .LT. 0.0) XEF = ABS(XEF)                              S1704000
383*            GO TO 505                                                     S1704010
384*      C     POINT                                                         S1704020
385*        490 IF (NTVS .GT. 1) GO TO 510                                    S1704030
386*            XEF = XDO(1)                                                  S1704040
387*        500 IF (XEF .LE. 0.0) GO TO 510                                   S1704050
388*      C     DOUBLE CHECK THE CALCULATION OF DISTANCE XEF.                 S1704060
389*        505 A4 = AX1(N)+XEF*(BX1(N)+XEF*CX1(N))                           S1704061
390*            B4 = AT+XEF*(BT+XEF*CT)                                       S1704062
391*            IF (ABS(A4-B4) .LE. 0.5) GO TO 520                            S1704070
392*            IF (X1 .LE. 0.0) GO TO 465                                    S1704080
393*        510 GO TO (280,290),KT                                            S1704090
394*        520 IF (A4 .LE. 0.0) GO TO 510                                    S1704100
395*      C     CALCULATE THE HEIGHT OF CURVE AT DISTANCE XEF.                S1704110
396*            B55 = AX2(N)+XEF*(BX2(N)+XEF*CX2(N))                          S1704120
396*            IF (B55 .LT. 0.0) GO TO 510                                   S1704121
397*      C     SETTLING VELOCITY VS.                                         S1704130
398*            VS = WSOCAN*(H-B55)/XEF                                       S1704140
399*            IF (VS .LE. 0.0) GO TO 510                                    S1704150
400*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9012) B5,XEF,A4,B4,B55,VS,AT,BT, S1704160
401*           *CT,XDO,VSSS                                                   S1704170
402*      C     CALC. FRACTION OF MATERIAL THAT REACHES Z BELOW CANOPY        S1704190
403*      C                                                                   S1704200
404*            DO 550 IG=1,NTVS                                              S1704250
405*            IF (A4 .GE. VSSS(IG)) GO TO 560                               S1704260
406*        550 CONTINUE                                                      S1704270
407*            IG = NTVS                                                     S1704280
408*      C     FRACTION OF MATERIAL LEFT AFTER EVAPORATION.                  S1704290
409*        560 X1 = A13(IG)+Z*(B13(IG)+Z*C13(IG))                           S1704300
410*      C     FRACTION OF MATERIAL LEFT AFTER LOSSES DUE TO IMPACTION WITHIN S1704310
411*      C     THE CANOPY.                                                   S1704320
412*            Y1 = CNTD(IZ,IG)                                              S1704330
413*            IF (IG .EQ. 1) GO TO 580                                      S1704340
414*            IF (IG .EQ. NTVS.AND.A4 .LT. VSSS(NTVS)) GO TO 580            S1704350
415*      C     MUST INTERPOLATE.                                             S1704360
416*            B55 = VSSS(IG)-VSSS(IG-1)                                     S1704370
417*            IF (B55) 570,580,570                                          S1704380
418*        570 B5 = A13(IG-1)+Z*(B13(IG-1)+Z*C13(IG-1))                      S1704390
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419*            X1 = X1-(X1-B5)*(VSSS(IG)-A4)/B55                                  S1704400
420*            Y1 = CNTD(IZ,IG)-(VSSS(IG)-A4)*(CNTD(IZ,IG)-CNTD(IZ,IG-1))/B55     S1704410
421*      C     FRACTION OF MATERIAL BELOW CANOPY THAT REACHES Z.                   S1704420
422*        580 FRACT = X1*Y1                                                       S1704430
423*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9013) A4,X1,Y1,B5,FRACT           S1704440
424*            IF (FRACT .LE. 0.0) GO TO (280,290),KT                             S1704450
425*        590 CONTINUE                                                           S1704460
426*      C                                                                        S1704461
427*      C     CALC. FRACTION OF MATERIAL REACHING CANOPY TOP (Z IF IZ = 0)        S1704462
428*      C                                                                        S1704463
429*      C     CALC. HEIGHT OF DROP TRAJECTORY AT DISTANCE XEF.                   S1704464
430*            B5 = AX2(N)+XEF*(BX2(N)+XEF*CX2(N))                                S1704465
431*      C     CALC. FRACTION OF MATERIAL REACHING HEIGHT OF DROP TRAJECTORY      S1704466
432*      C     AT DISTANCE XEF.                                                   S1704467
433*            B5 = AX3(N)+B5*(BX3(N)+B5*CX3(N))                                  S1704468
434*            IF (KT .NE. 2) GO TO 596                                           S1704469
435*      C     VAPOR MODEL (VOLUME SOURCE)                                        S170446A
436*            IF (B5 .GT. 0.0) GO TO 595                                         S170446B
437*            KN = 1                                                             S170446C
438*            B5 = 0.0                                                           S170446D
439*        595 B5 = 1.0-B5                                                        S170446E
440*            B55 = B5                                                           S170446F
441*            B5 = B5-VAP                                                        S170446G
442*            VAP = B55                                                          S170446H
443*      C     TOTAL FRACTION OF MATERIAL REACHING CALCULATION HEIGHT Z.           S170446I
444*        596 FRACT = FRACT*B5*PCTMAT(N)                                         S170446J
445*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9010) B5,FRACT                    S170446K
446*            IF (FRACT .LE. 0.0) GO TO (280,290),KT                             S170446L
447*      C                                                                        S170446M
448*      C                                                                        S170446N
449*      C                                                                        S170446O
450*      C                                                                        S170446P
451*            HP = H-HGTCAN(1)                                                   S1704470
452*      C                                                                        S1704480
453*      C                                                                        S1704490
454*      C     CALCULATE REFLECTION COEFFICIENT                                   S1704500
455*            IG = 1                                                             S1704510
456*            IF (VS .LT. VSGAM(1)) IG = 2                                       S1704520
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457*            IF (VS .LT. VSGAM(2)) IG = 3                                    S1704530
458*            GAMMAP = GAMA(IG)+VS*(GAMB(IG)+VS*GAMC(IG))                     S1704540
459*            IF (GAMMAP .LT. 0.0) GAMMAP = 0.0                               S1704550
460*            IF (GAMMAP .GT. 1.0) GAMMAP = 1.0                               S1704560
461*      C                                                                     S1704570
462*      C     APPLY CORRECTION FACTOR TO SIGEPR AND SIGAPR                    S1704580
463*      C                                                                     S1704590
464*            SIGEP = SIGEPR                                                  S1704600
465*            SIGAP = SIGAPR                                                  S1704610
466*            IF (BETA1) 640,640,600                                          S1704620
467*        600 AR2 = VS*UBARSI                                                 S1704630
468*            B6 = AR2*TT5                                                    S1704640
469*            IF (B6 .LE. .2386) GO TO 610                                    S1704650
470*            B6 = (TT6*AR2)**2                                               S1704660
471*            SIGEP = SIGEPR/(1.0+B6)**0.25                                   S1704670
472*            SIGAP = SIGAPR/(1.0+4.0*B6)**0.25                               S1704680
473*        610 A1 = SQR2*SIGAP                                                 S1704690
474*            A6 = 1.0/A1                                                     S1704700
475*            A8 = A6*UBARSI                                                  S1704710
476*            A5 = A6*TT3                                                     S1704720
477*            A7 = A5*A5                                                      S1704730
478*            TT5 = 1.0/SIGEP                                                 S1704740
479*            B1 = SIGXYZ*TT5                                                 S1704750
480*            A2 = SIGAP*TT5                                                  S1704760
481*            IF (SIGAP-SIGEP) 630,620,630                                    S1704770
482*        620 A2 = 1.0                                                        S1704780
483*        630 A3 = A2*TT10                                                    S1704790
484*            SK = A2                                                         S1704800
485*            A2 = A2*A2                                                      S1704810
486*            T5 = TT8*TT5                                                    S1704820
487*            B6 = 1.0/SIGAP                                                  S1704830
488*            T7 = SIGXYZ*B6                                                  S1704840
489*            T8 = TT8*B6                                                     S1704850
490*            IF (MODEL .EQ. 2) GO TO 640                                     S1704860
491*            SN2 = A3*TT7                                                    S1704870
492*            SN3 = 0.5*SN2*B6/SK                                             S1704880
493*        640 CONTINUE                                                        S1704890
494*      C                                                                     S1704900
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C                                                                       S1704310
C     CALCULATE XLRZ                                                    S1704920
C                                                                       S1704930
C                                                                       S1704940
      IF (XLRZ .LT. 0.0) XLRZY = WSOCAN*TIME                            S1704950
      IF (KT .EQ. 2) GO TO 650                                          S1704960
C                                                                       S1704970
C     CALCULATE XZ, XY VIRTUAL DISTANCES                                S1704980
C                                                                       S1704990
      IF (MODEL .EQ. 2) XY = T7-XLRZY                                   S1705000
      XZ = B1-XLRZY                                                     S1705010
      SIGXI = SIGX1                                                     S1705020
      GO TO 660                                                         S1705030
  650 XZ = T5-XLRZY                                                     S1705040
      IF (MODEL .EQ. 2) XY = T8-XLRZY                                   S1705050
      SIGXI = SIGX2                                                     S1705060
  660 IF (XZ .LT. 0.0) XZ = 0.0                                         S1705070
      IF (MODEL.EQ.2.AND.XY.LT.0.0) XY = 0.0                            S1705080
C     CALC. INVERSE SIGX MULTIPLIED BY 1/SQRT(2*PI)                     S1705090
      B55 = DELU*XPP                                                    S1705100
      SIGXI = 1.0/(2.5066283*SQRT(B55*B55+SIGXI))                       S1705110
C     GO CALC. SIGY, SIGZ, AP, SB, ETC.                                 S1705120
      CALL FOFX                                                         S1705130
      IF (API .LE. 0.0.OR.SBI .LE. 0.0) GO TO (280,290),KT             S1705140
      IF (ISW(4) .GE. 2) WRITE (IOTFIL,9014) XLRZY,XZ,API,SBI,SNMYP,    S1705150
     *SNMYPS,A10,UBARSI,UBARXI,A8,DEKAY,H,GAMMAP,SN2,SN3                S1705160
C                                                                       S1705170
C                                                                       S1705180
C     CONVERT GRAMS TO DROPS IF CONV(N) IS NOT EQUAL TO 1.0             S1705190
      FRACT = FRACT*CONV(N)                                             S1705200
C                                                                       S1705210
C                                                                       S1705220
C     CALCULATE MODEL EQUATIONS                                         S1705230
      GO TO (670,700,670),MODEL                                         S1705240
C                                                                       S1705250
C                                                                       S1705260
C                                                                       S1705270
C                                                                       S1705280
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533*      C      DOSAGE, CONCENTRATION AND DEPOSITION FROM LINE SOURCES NOT          S1705290
534*      C      NORMAL TO THE WIND DIRECTION.                                       S1705300
535*        670 CONTINUE                                                            S1705310
536*            IF (ISW(8) .LE. 0.OR.KT .EQ. 2) GO TO 680                           S1705320
537*      C     DEPOSITION                                                          S1705330
538*            KSW = 0                                                             S1705340
539*            HPP = HP-ZP                                                         S1705350
540*            HMP = HM-ZP                                                         S1705360
541*            CALL LNPN1                                                          S1705370
542*            TSUM1 = TSUM1+SUMN*FRACT*(1.0-GAMMAP)*DEKAY*SN2                     S1705380
543*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9015) SUMN,TSUM1                   S1705390
544*        680 IF (ISW(6) .LE. 0.AND.ISW(7) .LE. 0) GO TO 690                      S1705400
545*      C     DOSAGE AND/OR CONCENTRATION                                         S1705410
546*            KSW = 1                                                             S1705420
547*            HPP = HP                                                            S1705430
548*            HMP = HM                                                            S1705440
549*            CALL LNPN1                                                          S1705450
550*            B55 = SUMN*FRACT*DEKAY*SN3                                          S1705460
551*            TSUM2 = TSUM2+B55                                                   S1705470
552*            TSUM3 = TSUM3+B55*SIGXI                                             S1705480
553*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9016) SUMN,TSUM2,TSUM3,B55,SIGXI S1705490
554*        690 CONTINUE                                                            S1705500
555*            GO TO (280,290),KT                                                  S1705510
556*      C                                                                         S1705520
557*      C                                                                         S1705530
558*      C                                                                         S1705540
559*      C                                                                         S1705550
560*      C     DOSAGE, CONCENTRATION AND DEPOSITION FROM LINE SOURCES NORMAL       S1705560
561*      C     TO THE WIND DIRECTION.                                              S1705570
562*        700 CONTINUE                                                            S1705580
563*            AR1 = T10*SIGYI                                                     S1705590
564*            AR2 = T11*SIGYI                                                     S1705600
565*            AR3 = ERFXS(AR1)                                                    S1705610
566*            AR4 = ERFXS(AR2)                                                    S1705620
567*            SUMN = 0.5*(AR3+AR4)*DEKAY*FRACT                                    S1705630
568*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9017) T10,T11,AR1,AR2,AR3,AR4,DEKS1705640
569*           *AY,FRACT,SUMN                                                       S1705650
570*            IF (ISW(6) .LE. 0.AND.ISW(7) .LE. 0) GO TO 710                      S1705660
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571*            B4 = VS*UBARXI                                                  S1705570
572*            A4 = -HP+ZP+B4                                                  S1705580
573*            B4 = HP+ZP-B4                                                   S1705590
574*            HMP = HM                                                        S1705700
575*            B55 = VRTCL(A4,B4,0)                                            S1705710
576*            B55 = B55*SUMN/SIGZ*SN3                                         S1705720
577*            TSUM2 = TSUM2+B55                                               S1705730
578*            TSUM3 = TSUM3+B55*SIGXI                                         S1705740
579*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9018) B55,SIGYI,SIGZ,A4,B4,SIGXI S1705750
580*          710 IF (ISW(8) .LE. 0.OR.KT .EQ. 2) GO TO 690                     S1705760
581*            A4 = VS*UBARXI-(HP-ZP)                                          S1705770
582*            B4 = -XZ*UBARSI*VS-(HP-ZP)                                      S1705780
583*            HMP = HM-ZP                                                     S1705790
584*            B55 = VRTCL(A4,B4,1)                                            S1705800
585*            TSUM1 = TSUM1+B55*SUMN*SIGZI2*SN2                               S1705810
586*        C                                                                   S1705820
587*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9019) A4,B4,B55,SIGZ           S1705830
588*            GO TO 690                                                       S1705840
589*        C                                                                   S1705850
590*        C                                                                   S1705860
591*        C                                                                   S1705870
592*        C                                                                   S1705880
593*        C                                                                   S1705890
594*        C       CALCULATE FINAL RESULT                                      S1705900
595*        C                                                                   S1705910
596*        C                                                                   S1705920
597*          720 IF (ISW(8) .LE. 0) GO TO 730                                  S1705930
598*            CALC(II,3) = CALC(II,3)+TSUM1                                   S1705940
599*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9020) TSUM1,CALC(II,3)         S1705950
600*          730 IF (ISW(6) .LE. 0.AND.ISW(7) .LE. 0.0) GO TO 750              S1705960
601*            IF (ISW(7) .LE. 0) GO TO 740                                    S1705970
602*            CALC(II,2) = CALC(II,2)+TSUM3                                   S1705980
603*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9021) TSUM3,CALC(II,2)         S1705990
604*          740 IF (ISW(6) .LE. 0) GO TO 750                                  S1706000
605*            X1 = TSUM2                                                      S1706010
606*            IF (ISW(10) .EQ. 1) X1 = X1*.016666667                          S1706020
607*            X1 = X1*UBARSI                                                  S1706030
608*            CALC(II,1) = CALC(II,1)+X1                                      S1706040
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609*          IF (ISW(4) .GE. 2) WRITE (IOTFIL,9022) TSUM2,X1,CALC(II,1)          S1706050
610*       750 CONTINUE                                                           S1706060
611*          GO TO (170,200),M                                                   S1706070
612*       9001 FORMAT (16H1DETAIL SOURCE #,I3,7H DX,DY=,2F10.3,8H, DX,DY=,2F10.3)S1706080
613*       9002 FORMAT (7H MODEL=,I2,7H SIGAP=,E12.6,7H SIGEP=,E12.6,4H B3=,E12.6,S1706090
614*           *4H A1=,E12.6/4H A2=,E12.6,4H A3=,E12.6,4H SK=,E12.6,4H A6=,E12.6, S1706100
615*           */8H THETAP=,E12.6,4H B1=,E12.6,4H TL=,E12.6,5H GAM=,E12.6/6H ALPH=S1706110
616*           *,E12.6,5H BET=,E12.6,6H TSIN=,D15.8/6H TCOS=,D15.8,4H A5=,D15.8,  S1706120
617*           *6H RCOS=,E12.6,6H RSIN=,E12.6,4H A7=,D15.8,5H SN2=,E12.6/5H SN3=, S1706130
618*           *E12.6,4H T1=,E12.6,4H T2=,E12.6)                                  S1706140
619*       9003 FORMAT (///22H DETAIL FOR POINT I,J=,2I4,5H X,Y=,2E12.6,          S1706150
620*           *9H M,JJ,II=,3I4)                                                  S1706160
621*       9004 FORMAT (15H X1,Y1,XRR,YRR=,4E12.6)                                S1706170
622*       9005 FORMAT (17H XR,YR,XP,YP,XPP=,5E12.6)                              S1706180
623*       9006 FORMAT (12H N,IZ,MODEL=,3I8)                                      S1706190
624*       9007 FORMAT (20H XM,XPP,XP,YP,XR,YR=,6E14.8/17H XBAR,T10,T11,SL=,4E14.8S1706200
625*           *)                                                                 S1706210
626*       9008 FORMAT (13H VSP,B6,TIME=,3E14.8)                                  S1706220
627*       9009 FORMAT (14H B5,B55,VSP,H=,4E14.8)                                 S1706230
628*       9010 FORMAT (10H B5,FRACT=,2E14.8)                                     S1706240
629*       9011 FORMAT (4H VS=,E14.8)                                             S1706250
630*       9012 FORMAT (21H B5,XEF,A4,B4,B55,VS=,6E14.8/10H AT,BT,CT=,3E14.8/5H XDS1706260
631*           *O=,9E14.8/1X,9E14.8/1X,2E14.8/6H VSSS=,9E14.8/1X,9E14.8/1X,9E14.8)S1706270
632*       9013 FORMAT (19H A4,X1,Y1,B5,FRACT=,5E14.8)                            S1706280
633*       9014 FORMAT (31H XLRZY,XZ,API,SBI,SNMYP,SNMYPS=,2E14.8,4D14.8/28H A10,US1706290
634*           *BARSI,UBARXI,A8,DEKAY=,D14.8,2E14.8,D14.8,E14.8/10H H,GAMMAP=,2E14S1706300
635*           *.8,9H SN2,SN3=,2E14.8)                                            S1706310
636*       9015 FORMAT (12H DEP - SUMN=,D15.8,7H TSUM1=,E14.8)                    S1706320
637*       9016 FORMAT (16H DOS/CON - SUMN=,D15.8,7H TSUM2=,E14.8,7H TSUM3=,E14.8,S1706330
638*           *5H B55=,E14.8,7H SIGXI=,E14.8)                                    S1706340
639*       9017 FORMAT (25H T10,T11,AR1,AR2,AR3,AR4=,2E14.8,4D14.8/18H DEKAY,FRACTS1706350
640*           *,SUMN=,2E14.8,D14.8)                                              S1706360
641*       9018 FORMAT (28H B55,SIGYI,SIGZ,A4,B4,SIGXI=,6E14.8)                   S1706370
642*       9019 FORMAT (16H A4,B4,B55,SIGZ=,4E14.8)                               S1706380
643*       9020 FORMAT (13H DEP - TSUM1=,E14.8,5H DEP=,E14.8)                     S1706390
644*       9021 FORMAT (13H CON - TSUM3=,E14.8,                                   S1706400
645*           *5H CON=,E14.8)                                                    S1706410
646*       9022 FORMAT (13H DOS - TSUM2=,E14.8,4H X1=,E14.8,                      S1706420
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      SUBROUTINE FOFX                                                   S1800010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S1800020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S1800030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,SB,AP                     S1800040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S1800050
     *ISW(20),I,J,K,L,M,N,NVS                                           S1800060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S1800070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S1800080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S1800090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S1800100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S1800110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA     S1800120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S1800130
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S1800140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S1800150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGXI,S1800160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S1800170
      EQUIVALENCE (SIGZI,SNMYP),(SIGZ,SBI),(SIGYI,API),(XY,SNMYPS),     S1800180
     *(SIGZI2,APIP)                                                     S1800190
      INTEGER TITLE                                                     S1800200
      AR1 = XPP+XZ                                                      S1800210
      IF (MODEL .EQ. 2) GO TO 50                                        S1800220
      IF (MODEL .EQ. 3) GO TO 10                                        S1800230
      SNMYP = (XPP+XZ*TT1-YR*TSIN)*TT2                                  S1800240
      GO TO 20                                                          S1800250
   10 SNMYP = YP                                                        S1800260
   20 CONTINUE                                                          S1800270
      SNMYPS = SNMYP*SNMYP                                              S1800280
      A10 = A5*SNMYP                                                    S1800290
      AP = A1*AR1                                                       S1800300
      IF (AP .LT. 1.0E-20.AND.AP .GE. 0.0) AP = 1.0E-20                 S1800310
      API = 1.0/AP                                                      S1800320
      IF (SL .GE. 0.0) GO TO 30                                         S1800330
      SB = A1*(AR1-TT4)                                                 S1800340
      GO TO 40                                                          S1800350
   30 SB = A1*XZ                                                        S1800360
   40 IF (SB .LT. 1.0E-20.AND.SB .GE. 0.0) SB = 1.0E-20                 S1800370
      SBI = 1.0/SB                                                      S1800380
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39*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) XPP,XZ,A1,SL,TSIN,AP,SB     S1800390
40*          50 CONTINUE                                                           S1800400
41*            UBARXI = XZ*UBARSI                                                  S1800410
42*            IF (MODEL .NE. 2) GO TO 60                                          S1800420
43*            SIGZ = SIGEP*AR1                                                    S1800430
44*            SIGYI = 1.0/(SIGAP*(XPP+XY))                                        S1800440
45*            SIGZI2 = 1.0/(SIGZ*AR1)                                             S1800450
46*            UBARXI = XPP*UBARSI                                                 S1800460
47*            SIGZI = -0.5/(SIGZ*SIGZ)                                            S1800470
48*          60 CONTINUE                                                           S1800480
49*            DEKAY = 1.0                                                         S1800490
50*            IF (DECAY) 70,90,70                                                 S1800500
51*          70 CONTINUE                                                           S1800510
52*            SB = -DECAY*XPP*UBARSI                                              S1800520
53*            IF (SB .GT. 50.0) SB = 50.0                                         S1800530
54*            IF (SB .LT. -50.0) SB = -50.0                                       S1800540
55*            IF (MODEL .EQ. 2) GO TO 80                                          S1800550
56*            DEKAY = (WSOCAN/(XPP*DECAY))*(1.0-DEXP(SB))                         S1800560
57*            GO TO 90                                                            S1800570
58*          80 DEKAY = DEXP(SB)                                                   S1800580
59*          90 CONTINUE                                                           S1800590
60*            RETURN                                                              S1800600
61*        9001 FORMAT (25H XPP,XZ,A1,SL,TSIN,AP,SB=,7E12.6)                       S1800610
62*            END                                                                 S1800620
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```
      FUNCTION ERFXS(X)                                                 S1900010
C     ERROR FUNCTION                                                    S1900020
      DOUBLE PRECISION A1,A2,A3,A4,A5,A6,X,A,B                          S1900030
      DATA A1,A2,A3,A4,A5,A6/.07052307840D0,.0422820123D0,.0092705272D0, S1900040
     *.0001520143D0,.0002765672D0,.0000430638D0/                        S1900050
      I = 0                                                             S1900060
      IF (X .LT. 0.0) I = 1                                             S1900070
      A = DABS(X)                                                       S1900080
      IF (A .LE. 1.0E-11) GO TO 30                                      S1900090
      IF (A .GE. 5.0) GO TO 10                                          S1900100
      B = 1.0+A*(A1+A*(A2+A*(A3+A*(A4+A*(A5+A*A6)))))                   S1900110
      A = 1.0-1.0/B**16                                                 S1900120
      GO TO 20                                                          S1900130
   10 A = 1.0                                                           S1900140
   20 IF (I .NE. 0) A = -A                                              S1900150
   30 ERFXS = A                                                         S1900160
      RETURN                                                            S1900170
      END                                                               S1900180
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```
      FUNCTION VRTCL(P1,P2,LL)                                          S2000010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2000020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S2000030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,SB,AP                     S2000040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2000050
     *ISW(20),I,J,K,L,M,N,NVS                                           S2000060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2000070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,  S2000080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S2000090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S2000100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2000110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA     S2000120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S2000130
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S2000140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2000150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2000160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2000170
      EQUIVALENCE (SIGZI,SNMYP),(SIGZ,SBI),(SIGYI,API),(XY,SNMYPS)      S2000180
      INTEGER TITLE                                                     S2000190
      RESLT = 0.0                                                       S2000200
      IF (SIGZI .GE. 0.0) GO TO 40                                      S2000210
      IF (LL .NE. 0) GO TO 50                                           S2000220
      AR1 = P2*P2*SIGZI                                                 S2000230
      IF (AR1 .LT. -40.0) GO TO 10                                      S2000240
      RESLT = DEXP(AR1)*GAMMAP                                          S2000250
   10 AR2 = P1*P1*SIGZI                                                 S2000260
      IF (AR2 .GE. -40.0) RESLT = RESLT+DEXP(AR2)                       S2000270
C                                                                       S2000280
      AR1 = 1.0                                                         S2000290
      AR2 = GAMMAP                                                      S2000300
      AR3 = AR2*AR2                                                     S2000310
      KSW = 0                                                           S2000320
   20 KSW = KSW+2                                                       S2000330
      AR4 = KSW*HMP                                                     S2000340
      AR5 = AR4-P2                                                      S2000350
      AR5 = AR5*AR5*SIGZI                                               S2000360
      IF (AR5 .LT. -40.0) AR5 = -40.0                                   S2000370
      IF (KSW .LE. 2) GO TO 30                                          S2000380
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      FUNCTION VRTCL(P1,P2,LL)                                                  S2000010
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,                   S2000020
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN                 S2000030
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,SB,AP                             S2000040
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40),         S2000050
     *ISW(20),I,J,K,L,M,N,NVS                                                   S2000060
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),                       S2000070
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUD,SIGXYZ,XLRZ,          S2000080
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEFLV(10),           S2000090
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),          S2000100
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2000110
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA             S2000120
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)               S2000130
      COMMON /COM3/ CALC(737,3),XPF,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,          S2000140
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2,         S2000150
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2000160
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP             S2000170
      EQUIVALENCE (SIGZI,SNMYP),(SIGZ,SBI),(SIGYI,API),(XY,SNMYPS)             S2000180
      INTEGER TITLE                                                             S2000190
      RESLT = 0.0                                                               S2000200
      IF (SIGZI .GE. 0.0) GO TO 40                                              S2000210
      IF (LL .NE. 0) GO TO 50                                                   S2000220
      AR1 = P2*P2*SIGZI                                                         S2000230
      IF (AR1 .LT. -40.0) GO TO 40                                              S2000240
      AR2 = P1*P1*SIGZI                                                         S2000250
      IF (AR2 .LT. -40.0) GO TO 10                                              S2000260
      RESLT = DEXP(AR2)                                                         S2000270
   10 RESLT = RESLT+DEXP(AR1)*GAMMAP                                            S2000280
      AR1 = 1.0                                                                 S2000290
      AR2 = GAMMAP                                                              S2000300
      AR3 = AR2*AR2                                                             S2000310
      KSW = 0                                                                   S2000320
   20 KSW = KSW+2                                                               S2000330
      AR4 = KSW*HMP                                                             S2000340
      AR5 = AR4-P2                                                              S2000350
      AR5 = AR5*AR5*SIGZI                                                       S2000360
      IF (AR5 .LT. -40.0) AR5 = -40.0                                           S2000370
      IF (KSW .LE. 2) GO TO 30                                                  S2000380
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39*           IF (AR5 .LT. -10.0) GO TO 40                                          S2000390
40*         30 T2 = AR4+P1                                                          S2000400
41*           T3 = AR4-P1                                                           S2000410
42*           T4 = AR4+P2                                                           S2000420
43*           T2 = T2*T2*SIGZI                                                      S2000430
44*           T3 = T3*T3*SIGZI                                                      S2000440
45*           T4 = T4*T4*SIGZI                                                      S2000450
46*           IF (T2 .LT. -40.0) T2 = -40.0                                         S2000460
47*           IF (T3 .LT. -40.0) T3 = -40.0                                         S2000470
48*           IF (T4 .LT. -40.0) T4 = -40.0                                         S2000480
49*           BB2 = AR1*DEXP(AR5)+AR2*(EXP(T2)+EXP(T3))+AR3*EXP(T4)                 S2000490
50*           RESLT = RESLT+BB2                                                     S2000500
51*           IF (BB2 .LE. RESLT*1.0E-6) GO TO 40                                   S2000510
52*           IF (GAMMAP .LE. 0.0) GO TO 40                                         S2000520
53*           AR1 = AR2                                                             S2000530
54*           AR2 = AR3                                                             S2000540
55*           AR3 = AR3*GAMMAP                                                      S2000550
56*           GO TO 20                                                              S2000560
57*         40 CONTINUE                                                             S2000570
58*           VRTCL = RESLT                                                         S2000580
59*           RETURN                                                                S2000590
60*         50 IF (GAMMAP .GE. 1.0) GO TO 40                                        S2000600
61*           AR1 = P1*P1*SIGZI                                                     S2000610
62*           IF (AR1 .LT. -40.0) AR1 = -40.0                                       S2000620
63*           RESLT = -P2*DEXP(AR1)                                                 S2000630
64*           AR1 = 1.0                                                             S2000640
65*           KSW = 0                                                               S2000650
66*         60 KSW = KSW+2                                                          S2000660
67*           AR4 = KSW*HMP                                                         S2000670
68*           AR5 = AR4-P1                                                          S2000680
69*           AR2 = AR4+P1                                                          S2000690
70*           AR5 = AR5*AR5*SIGZI                                                   S2000700
71*           AR2 = AR2*AR2*SIGZI                                                   S2000710
72*           IF (KSW .LE. 2) GO TO 70                                              S2000720
73*           IF (AR5 .LT. -10.0.AND.AR2 .LT. -10.0) GO TO 80                       S2000730
74*         70 RESLT = RESLT+AR1*((AR4+P2)*DEXP(AR2)+GAMMAP*(AR4-P2)*DEXP(AR5)      S2000740
75*           *)                                                                    S2000750
76*           IF (GAMMAP .LE. 0.0) GO TO 80                                         S2000760
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      SUBROUTINE LNPN1                                                  S2100010
C     KSW = 0 IS DEPOSITION                                             S2100020
C     KSW = 1 IS DOSAGE (CONCENTRATION)                                 S2100030
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2100040
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S2100050
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,TMP1,TMP2,TMP3,TMP4,      S2100060
     *SUM,BB,TMP5,TMP6                                                  S2100070
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2100080
     *ISW(20),I,J,K,L,M,N,NVS                                           S2100090
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2100100
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S2100110
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),    S2100120
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),   S2100130
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2100140
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA     S2100150
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)        S2100160
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S2100170
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2100180
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2100190
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2100200
      INTEGER TITLE                                                     S2100210
      SUMN = 0.0                                                        S2100220
      GAM1 = 1.0                                                        S2100230
      GAM2 = GAMMAP                                                     S2100240
      TMP6 = VS*A8                                                      S2100250
      TMP2 = SNMYPS/A2                                                  S2100260
      TMP3 = TMP6*A2                                                    S2100270
      TMP1 = TMP6*SK                                                    S2100280
      TMP5 = A10/SK                                                     S2100290
      PP = TMP6*TMP3+A7                                                 S2100300
      BB = HPP+VS*UBARXI                                                S2100310
      APIP = API                                                        S2100320
      SBIP = SBI                                                        S2100330
      BB1 = BB                                                          S2100340
      BB2 = SQRP                                                        S2100350
      IF (KSW .NE. 0) GO TO 10                                          S2100360
      FF = A2*BB*BB+SNMYPS                                              S2100370
      GG = 2.0*(TMP3*BB+A10)                                            S2100380
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```
39*           GO TO 20                                                                S2100390
40*        10 BB1 = 3.14159265                                                        S2100400
41*           TMP4 = -BB+ZP                                                           S2100410
42*           FF = TMP2+TMP4*TMP4                                                     S2100420
43*           GG = -2.0*(TMP1*TMP4-TMP5)                                              S2100430
44*           APIP = API*SK                                                           S2100440
45*           SBIP = SBI*SK                                                           S2100450
46*        20 CALL LNPN2(1.0)                                                         S2100460
47*           IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) TMP1,TMP2,TMP3,PP,BB,APIP,       S2100470
48*          *SBIP,BB1,BB2,FF,GG,TMP4,A2,SNMYPS                                       S2100480
49*           SUMN = SUMN+RESLT                                                       S2100490
50*           IF (KSW .EQ. 0) GO TO 30                                                S2100500
51*           TMP4 = BB+ZP                                                            S2100510
52*           FF = TMP2+TMP4*TMP4                                                     S2100520
53*           GG = 2.0*(TMP1*TMP4+TMP5)                                               S2100530
54*           CALL LNPN2(GAM2)                                                        S2100540
55*           SUMN = SUMN+RESLT                                                       S2100550
56*           GAM3 = GAM2*GAMMAP                                                      S2100560
57*           GO TO 40                                                                S2100570
58*        30 CONTINUE                                                                S2100580
59*        40 AA = 0.0                                                                S2100590
60*        50 AA = AA+2.0                                                             S2100600
61*           CC = AA*HM                                                              S2100610
62*           SUM = 0.0                                                               S2100620
63*           IF (KSW .NE. 0) GO TO 60                                                S2100630
64*           BB1 = CC-BB                                                             S2100640
65*           FF = A2*BB1*BB1+SNMYPS                                                  S2100650
66*           GG = -2.0*(TMP3*BB1-A10)                                                S2100660
67*           GO TO 70                                                                S2100670
68*        60 TMP4 = CC-BB-ZP                                                         S2100680
69*           FF = TMP2+TMP4*TMP4                                                     S2100690
70*           GG = -2.0*(TMP1*TMP4-TMP5)                                              S2100700
71*        70 CALL LNPN2(GAM1)                                                        S2100710
72*           SUM = SUM+RESLT                                                         S2100720
73*           IF (KSW .NE. 0) GO TO 80                                                S2100730
74*           BB1 = CC+BB                                                             S2100740
75*           FF = A2*BB1*BB1+SNMYPS                                                  S2100750
76*           GG = 2.0*(TMP3*BB1+A10)                                                 S2100760
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```
 77*           GO TO 90                                                          S2100770
 78*        80 TMP4 = CC+BB-ZP                                                   S2100780
 79*           FF = TMP2+TMP4*TMP4                                               S2100790
 80*           GG = 2.0*(TMP1*TMP4+TMP5)                                         S2100800
 81*        90 CALL LNPN2(GAM2)                                                  S2100810
 82*           SUM = SUM+RESLT                                                   S2100820
 83*           IF (KSW .EQ. 0) GO TO 100                                         S2100830
 84*           TMP4 = CC-BB+ZP                                                   S2100840
 85*           FF = TMP2+TMP4*TMP4                                               S2100850
 86*           GG = -2.0*(TMP1*TMP4-TMP5)                                        S2100860
 87*           CALL LNPN2(GAM2)                                                  S2100870
 88*           SUM = SUM+RESLT                                                   S2100880
 89*           TMP4 = CC+BB+ZP                                                   S2100890
 90*           FF = TMP2+TMP4*TMP4                                               S2100900
 91*           GG = 2.0*(TMP1*TMP4+TMP5)                                         S2100910
 92*           CALL LNPN2(GAM3)                                                  S2100920
 93*           SUM = SUM+RESLT                                                   S2100930
 94*           GAM3 = GAM3*GAMMAP                                                S2100940
 95*       100 IF (GAMMAP .LE. 0.0) GO TO 120                                    S2100950
 96*           GAM1 = GAM2                                                       S2100960
 97*           GAM2 = GAM2*GAMMAP                                                S2100970
 98*           IF (AA .LE. 2.0) GO TO 110                                        S2100980
 99*           IF (SUM .LE. 1.0E-6*SUMN) GO TO 120                               S2100990
100*       110 SUMN = SUMN+SUM                                                   S2101000
101*           GO TO 50                                                          S2101010
102*       120 SUMN = SUMN+SUM                                                   S2101020
103*           RETURN                                                            S2101030
104*      9001 FORMAT (14H LNPN1 - TMP1=,D20.12,6H TMP2=,D20.12,6H TMP3=,D20.12, S2101040
105*          */4H PP=,D20.12,4H BB=,D20.12,6H APIP=,D20.12/                    S2101050
106*          *6H SBIP=,D20.12,5H BB1=,D20.12,5H BB2=,D20.12/                   S2101060
107*          *4H FF=,D20.12,4H GG=,D20.12,6H TMP4=,D20.12/                     S2101070
108*          *4H A2=,D20.12,8H SNMYPS=,D20.12)                                 S2101080
109*           END                                                              S2101090
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      SUBROUTINE LNPN2(GAM)                                              S2200010
C     KSW = 0 IS DEPOSITION                                              S2200020
C     KSW = 1 IS DOSAGE (CONCENTRATION)                                  S2200030
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,            S2200040
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN          S2200050
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4,TMP1,TMP2,TMP3            S2200060
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40),  S2200070
     *ISW(20),I,J,K,L,M,N,NVS                                            S2200080
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),                S2200090
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S2200100
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),    S2200110
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),   S2200120
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2200130
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA     S2200140
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)        S2200150
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,   S2200160
     *SNMYP,SNMYPS,A10,AFI,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2,  S2200170
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2200180
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP      S2200190
      INTEGER TITLE                                                      S2200200
      TMP1 = DSQRT(FF)                                                   S2200210
      TMP2 = 0.5/FF                                                      S2200220
      TMP3 = GG*TMP2                                                     S2200230
      AR1 = BB1*TMP2                                                     S2200240
      AR2 = 0.5*GG*TMP3-PP                                               S2200250
      AR3 = (APIP-TMP3)*TMP1                                             S2200260
      AR4 = (SBIP-TMP3)*TMP1                                             S2200270
      IF (KSW .EQ. 1) GO TO 10                                           S2200280
      AR5 = (GG*0.5/TMP1)*BB2                                            S2200290
      GO TO 20                                                           S2200300
   10 AR1 = DSQRT(AR1)                                                   S2200310
      AR5 = 1.0                                                          S2200320
   20 RESLT = AR5*(ERFXS(AR4)-ERFXS(AR3))                                S2200330
      IF (KSW .NE. 0) GO TO 30                                           S2200340
      AR4 = AR4*AR4                                                      S2200350
      AR3 = AR3*AR3                                                      S2200360
      TMP2 = 0.0                                                         S2200370
      IF (AR4 .LT. 50.0) TMP2 = DEXP(-AR4)                               S2200380
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39*            TMP3 = 0.0                                                        S2200390
40*            IF (AR3 .LT. 50.0) TMP3 = DEXP(-AR3)                              S2200400
41*            RESLT = RESLT+(TMP3-TMP2)                                         S2200410
42*         30 IF (AR2 .GT. 50.0) AR2 = 50.0                                     S2200420
43*            TMP2 = 0.0                                                        S2200430
44*            IF (AR2 .GT. -50.0) TMP2 = DEXP(AR2)                              S2200440
45*            RESLT = AR1*TMP2*RESLT*GAM                                        S2200450
46*            IF (ISW(4) .GE. 2) WRITE (IOTFIL,9001) KSW,BB1,FF,GG,PP,APIP,SBIP,S2200460
47*           *BB2,AR1,AR2,AR3,AR4,AR5,TMP1,RESLT                                S2200470
48*            IF (RESLT .LT. 0.0) RESLT = 0.0                                   S2200480
49*            RETURN                                                            S2200490
50*       9001 FORMAT (5H KSW=,I2,5H BB1=,D15.8,4H FF=,D15.8,4H GG=,D15.8,       S2200500
51*           *4H PP=,D15.8/6H APIP=,D15.8,6H SBIP=,D15.8,5H BB2=,D15.8,         S2200510
52*           *5H AR1=,D15.8/5H AR2=,D15.8,5H AR3=,D15.8,5H AR4=,D15.8,5H AR5=,  S2200520
53*           *D15.8/6H TMP1=,D15.8,7H RESLT=,D15.8)                             S2200530
54*            END                                                               S2200540
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1*            SUBROUTINE CBGS6                                                    S2300010
2*            DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,             S2300020
3*           *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN           S2300030
4*           *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4                             S2300040
5*            COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40),   S2300050
6*           *ISW(20),I,J,K,L,M,N,NVS                                             S2300060
7*            COMMON /COM2/ DELTAH,WSQCAN,HGTCAN(3),Q,PCTMAT(20),                 S2300070
8*           *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUQ,SIGXYZ,XLRZ,    S2300080
9*           *HM,DX(200),DY(200),X(100),Y(100),DQSLV(10),CONLV(10),DEPLV(10),     S2300090
10*          *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),    S2300100
11*          *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),  S2300110
12*          *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA      S2300120
13*          *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)         S2300130
14*           COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,   S2300140
15*          *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2,  S2300150
16*          *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1, S2300160
17*          *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP       S2300170
18*           DIMENSION AREAC(10,3),CONS1(6),CONS2(5)                            S2300180
19*           EQUIVALENCE (AREAC(1,1),DQSLV(1)),(COVR,BB1),(NXXYY,AR5),(CMAX,AR1 S2300190
20*          *),(XMX,AR2),(YMX,AR3),(CONST,AR4)                                  S2300200
21*           INTEGER TITLE                                                      S2300210
22*           DATA CONS1/1.0,1.0E6,1.0E3,1.0,.035274,.002204623/                 S2300220
23*           DATA CONS2/2.83169E-2,9.290339E-2,4046.873,1.0,10000.0/            S2300230
24*     C                                                                        S2300240
25*     C     SUBROUTINE TO PRINT DISPERSION MODEL CALCULATIONS                  S2300250
26*     C                                                                        S2300260
27*     C                                                                        S2300270
28*           NXXYY = NXPNTS*NYPNTS                                              S2300280
29*           DO 230 K=1,3                                                       S2300290
30*           IF (ISW(K+5) .LE. 0) GO TO 230                                     S2300300
31*           IF (K .EQ. 3) GO TO 10                                             S2300310
32*           IF (Z .GE. HGTCAN(1)) GO TO 10                                     S2300320
33*           WRITE (IOTFIL,9001)                                                S2300330
34*           GO TO 230                                                          S2300340
35*        10 CONTINUE                                                           S2300350
36*           I = ISW(9)+1                                                       S2300360
37*           CONST = CONS1(I)                                                   S2300370
38*           I = 4                                                              S2300380
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39*            IF (K .EQ. 3) GO TO 20                                    S2300390
40*            IF (ISW(11) .EQ. 1.OR.ISW(11) .EQ. 3) I = 1               S2300400
41*            GO TO 30                                                  S2300410
42*         20 IF (ISW(11) .EQ. 1) I = 2                                 S2300420
43*            IF (ISW(11) .GE. 2) I = 3                                 S2300430
44*            IF (ISW(11) .EQ. 4) I = 4                                 S2300440
45*         30 CONST = CONST*CONS2(I)                                    S2300450
46*            LINE = 57                                                 S2300460
47*      C     DETERMINE MAXIMUM VALUE AND LOCATION                      S2300470
48*            CMAX = 0.0                                                S2300480
49*            XMX = X(1)                                                S2300490
50*            YMX = Y(1)                                                S2300500
51*            IF (NYPNTS .LE. 0) GO TO 50                               S2300510
52*            DO 40 J=1,NYPNTS                                          S2300520
53*            I1 = (J-1)*NXPNTS                                         S2300530
54*            DO 40 I=1,NXPNTS                                          S2300540
55*            CALC(I+I1,K) = CALC(I+I1,K)*CONST                         S2300550
56*            IF (CALC(I+I1,K) .LE. CMAX) GO TO 40                      S2300560
57*            CMAX = CALC(I+I1,K)                                       S2300570
58*            XMX = X(I)                                                S2300580
59*            YMX = Y(J)                                                S2300590
60*         40 CONTINUE                                                  S2300600
61*         50 IF (NXYPNT .LE. 0) GO TO 70                               S2300610
62*            DO 60 I=1,NXYPNT                                          S2300620
63*            CALC(I+NXXYY,K) = CALC(I+NXXYY,K)*CONST                   S2300630
64*            IF (CALC(I+NXXYY,K) .LE. CMAX) GO TO 60                   S2300640
65*            CMAX = CALC(I+NXXYY,K)                                    S2300650
66*            XMX = X(NXPNTS+I)                                         S2300660
67*            YMX = Y(NYPNTS+I)                                         S2300670
68*         60 CONTINUE                                                  S2300680
69*         70 CONTINUE                                                  S2300690
70*      C                                                               S2300700
71*      C     PRINT CALCULATIONS AT GRID SYSTEM RECEPTORS                S2300710
72*      C                                                               S2300720
73*            I4 = 1                                                    S2300730
74*            I2 = 0                                                    S2300740
75*         80 I1 = I2+1                                                 S2300750
76*            IF (I1 .GT. NXPNTS) GO TO 110                             S2300760
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     I2 = I1+8                                                                  S2300770
     IF (I2 .GT. NXPNTS) I2 = NXPNTS                                            S2300780
     I3 = NYPNTS+1                                                              S2300790
  90 I3 = I3-1                                                                  S2300800
     IF (I3 .LE. 0) GO TO 100                                                   S2300810
     I5 = (I3-1)*NXPNTS                                                         S2300820
     CALL TITLR(I4,CMAX,XMX,YMX,I1,I2,0)                                        S2300830
     I4 = 0                                                                     S2300840
     WRITE (IOTFIL,9002) Y(I3),(CALC(I5+I,K),I=I1,I2)                           S2300950
     GO TO 90                                                                   S2300860
 100 I4 = -1                                                                    S2300870
     GO TO 80                                                                   S2300880
C                                                                               S2300890
C    PRINT CALCULATIONS AT DISCRETE RECEPTORS                                   S2300900
C                                                                               S2300910
 110 I2 = 0                                                                     S2300920
     IF (NXPNTS .GT. 0) I4 = -1                                                 S2300930
 120 I1 = I2+1                                                                  S2300940
     IF (I1 .GT. NXYPNT) GO TO 130                                              S2300950
     I2 = I1+2                                                                  S2300960
     IF (I2 .GT. NXYPNT) I2 = NXYPNT                                            S2300970
     CALL TITLR(I4,CMAX,XMX,YMX,I1,I2,1)                                        S2300980
     I4 = 0                                                                     S2300990
     WRITE (IOTFIL,9003) (X(NXPNTS+I),Y(NYPNTS+I),CALC(I+NXXYY,K),I=I1,         S2301000
    *I2)                                                                        S2301010
     GO TO 120                                                                  S2301020
 130 IF (ISW(12) .LE. 0) GO TO 230                                              S2301030
C                                                                               S2301040
C    CALCULATE AREA OF COVERAGE                                                 S2301050
C                                                                               S2301060
     IF (AREAC(1,K) .LE. 0.0) GO TO 230                                         S2301070
     I4 = -1                                                                    S2301080
     DO 220 I3=1,10                                                             S2301090
     COVR = 0.0                                                                 S2301100
     IF (NYPNTS .LE. 0) GO TO 190                                               S2301110
     DO 180 J=1,NYPNTS                                                          S2301120
     I1 = (J-1)*NXPNTS                                                          S2301130
     YP = Y(1)                                                                  S2301140
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115*            YR = Y(1)+100.0                                          S2301150
116*            IF (NYPNTS .LE. 1) GO TO 150                             S2301160
117*            YR = Y(2)                                                S2301170
118*            IF (J .EQ. 1) GO TO 150                                  S2301180
119*            IF (J .NE. NYPNTS) GO TO 140                             S2301190
120*            YP = Y(NYPNTS-1)                                         S2301200
121*            YR = Y(NYPNTS)                                           S2301210
122*            GO TO 150                                                S2301220
123*        140 YP = 0.5*(Y(J+1)-Y(J-1))                                 S2301230
124*            YR = 0.0                                                 S2301240
125*        150 YP = YP-YR                                               S2301250
126*            DO 180 I=1,NXPNTS                                        S2301260
127*            IF (CALC(I+I1,K) .LT. AREAC(I3,K)) GO TO 180             S2301270
128*            XP = X(1)                                                S2301280
129*            XR = X(1)+100.0                                          S2301290
130*            IF (NXPNTS .LE. 1) GO TO 170                             S2301300
131*            XR = X(2)                                                S2301310
132*            IF (I .EQ. 1) GO TO 170                                  S2301320
133*            IF (I .NE. NXPNTS) GO TO 160                             S2301330
134*            XP = X(NXPNTS-1)                                         S2301340
135*            XR = X(NXPNTS)                                           S2301350
136*            GO TO 170                                                S2301360
137*        160 XP = 0.5*(X(I+1)-X(I-1))                                 S2301370
138*            XR = 0.0                                                 S2301380
139*        170 XP = XP-XR                                               S2301390
140*            COVR = COVR+ABS(YP*XP)                                   S2301400
141*        180 CONTINUE                                                 S2301410
142*        190 IF (NXYPNT .LE. 0) GO TO 210                             S2301420
143*      C                                                              S2301430
144*      C     AREA OF COVERAGE FOR DISCRETE RECEPTORS                  S2301440
145*      C                                                              S2301450
146*            DO 200 I=1,NXYPNT                                        S2301460
147*            IF (CALC(I+NXXYY,K) .LT. AREAC(I3,K)) GO TO 200          S2301470
148*            COVR = COVR+DAREA                                        S2301480
149*        200 CONTINUE                                                 S2301490
150*        210 CALL TITLR(I4,CMAX,XMX,YMX,I1,I2,2)                      S2301500
151*            I4 = 0                                                   S2301510
152*            IF (ISW(11) .EQ. 1) COVR = COVR*10.76387                 S2301520
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```
153*            IF (ISW(11) .GE. 2) COVR = COVR*2.47104E-4                      S2301530
154*            WRITE (IOTFIL,9004) AREAC(I3,K),COVR                            S2301540
155*         220 CONTINUE                                                       S2301550
156*         230 CONTINUE                                                       S2301560
157*            WRITE (IOTFIL,9005)                                             S2301570
158*            STOP                                                            S2301580
159*        9001 FORMAT (67H1 *** ERROR - CANNOT CALCULATE DOSAGE OR CONCENTRATION S2301590
160*           *BELOW CANOPY)                                                   S2301600
161*        9002 FORMAT (1X,F9.2,9E13.6)                                        S2301610
162*        9003 FORMAT (3(1X,F9.2,3X,F9.2,2X,E13.4))                           S2301620
163*        9004 FORMAT (46X,E14.8,7X,E14.8)                                    S2301630
164*        9005 FORMAT (38H1 ******* END OF FSCBG PROGRAM *******)             S2301640
165*            END                                                             S2301650
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      SUBROUTINE TITLR(IN,CMAX,XMX,YMX,J1,J2,JN)                        S2400310
      DOUBLE PRECISION TSIN,TCOS,A5,XPP,RAD,SNMYP,SNMYPS,A10,           S2400320
     *AR1,AR2,AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,RESLT,SUMN         S2400330
     *,SBI,API,A8,XR,YR,A7,A2,TT1,TT2,TT3,TT4                           S2400340
      COMMON /COM1/ INPFIL,IOTFIL,LINE,IPAGE,ITABLE,IDATE(3),TITLE(40), S2400350
     *ISW(20),I,J,K,L,M,N,NVS                                           S2400360
      COMMON /COM2/ DELTAH,WSOCAN,HGTCAN(3),Q,PCTMAT(20),               S2400370
     *Z,NSOURC,NXPNTS,NYPNTS,NXYPNT,SIGAP,SIGEP,TAU,TAUO,SIGXYZ,XLRZ,   S2400380
     *HM,DX(200),DY(200),X(100),Y(100),DOSLV(10),CONLV(10),DEPLV(10),   S2400390
     *AX1(20),BX1(20),CX1(20),AX2(20),BX2(20),CX2(20),AX3(20),BX3(20),  S2400400
     *CX3(20),CNTD(11,20),DISTM(11,20),AX4(20),BX4(20),CX4(20),VSSS(20),S2400410
     *A13(20),B13(20),C13(20),WAKVEL,WNGSPN,HGTCFT,THETA,SWATH,DAREA     S2400420
     *,BETA1,GAMA(3),GAMB(3),GAMC(3),VSGAM(2),DECAY,DELU,CONV(20)       S2400430
      COMMON /COM3/ CALC(737,3),XPP,YP,XR,YR,XZ,TCOS,TSIN,A5,A1,TL,A6,  S2400440
     *SNMYP,SNMYPS,A10,API,SBI,A8,UBARXI,UBARSI,A2,SK,A7,DEKAY,AR1,AR2, S2400450
     *AR3,AR4,AR5,BB1,FF,GG,PP,APIP,SBIP,BB2,KSW,MODEL,RESLT,SUMN,SIGX1,S2400460
     *A4,RAD,SQR2,SQRP,H,VS,TT1,TT2,TT3,TT4,SL,GAMMAP,ZP,HMP,HP,HPP     S2400470
      DIMENSION LABL1(5,6),LABL2(2,3),LABL3(28),LABL4(7,3)              S2400480
      INTEGER TITLE                                                     S2400490
      DATA LABL1/2HDR,2HOP,1HS,2*1H ,2HMI,2HCR,2HCG,2HRA,2HMS,          S2400500
     *           2HMI,2HLL,2HIG,2HRA,2HMS,2HGR,2HAM,2HS ,2H  ,2H  ,    S2400510
     *           2HOU,2HNC,2HES,2H  ,2H  ,2HPO,2HUN,2HDS,2H  ,2H  /    S2400520
      DATA LABL2/2HSE,2HC.,2HMI,2HN.,2*1H /                             S2400530
      DATA LABL3/2HCU,2HBI,1HC,1H ,2HS0,2HUA,2HRE,1H ,2HME,2HTE,1HR,1H ,S2400540
     *     2HFO,2HOT,2*1H ,2HAC,2HRE,2*1H ,2HHE,2HCT,2HAR,1HE,4*1H /    S2400550
      DATA LABL4/2HDO,2HSA,2HGE,4*1H ,2HCO,2HNC,2HEN,2HTR,2HAT,2HIO,1HN,S2400560
     *           2HDE,2HPO,2HSI,2HTI,2HON,2*1H /                        S2400570
      IF (IN .LT. 0) GO TO 30                                           S2400580
      IF (IN .EQ. 1) GO TO 10                                           S2400590
      LINE = LINE+1                                                     S2400600
      IF (LINE .LT. 57) GO TO 160                                       S2400610
   10 LINE = 3                                                          S2400620
      IPAGE = IPAGE+1                                                   S2400630
      WRITE (IOTFIL,9001) (TITLE(I),I=1,20),IDATE,IPAGE                 S2400640
      IF (IN .EQ. 1) GO TO 20                                           S2400650
      WRITE (IOTFIL,9002) ITABLE                                        S2400660
      GO TO 40                                                          S2400670
   20 ITABLE = ITABLE+1                                                 S2400680
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      WRITE (IOTFIL,9003) ITABLE                                        S2400390
      GO TO 40                                                          S2400400
   30 IF (LINE+10 .GE. 57) GO TO 10                                     S2400410
      WRITE (IOTFIL,9004)                                               S2400420
      LINE = LINE+5                                                     S2400430
      GO TO 130                                                         S2400440
   40 L1 = ISW(9)+1                                                     S2400450
      GO TO (50,60,80),K                                                S2400460
   50 L2 = 1                                                            S2400470
      IF (ISW(10) .NE. 0) L2 = 2                                        S2400480
      GO TO 70                                                          S2400490
   60 L2 = 3                                                            S2400500
   70 L3 = 0                                                            S2400510
      L4 = 8                                                            S2400520
      IF (ISW(11) .EQ. 1.OR.ISW(11) .EQ. 3) L4 = 12                     S2400530
      GO TO 100                                                         S2400540
   80 L2 = 3                                                            S2400550
      L3 = 4                                                            S2400560
      IF (ISW(11) .GE. 2) GO TO 90                                      S2400570
      L4 = 8                                                            S2400580
      IF (ISW(11) .EQ. 1) L4 = 12                                       S2400590
      GO TO 100                                                         S2400600
   90 L3 = 16                                                           S2400610
      IF (ISW(11) .EQ. 4) L3 = 20                                       S2400620
      L4 = 24                                                           S2400630
  100 L5 = 4                                                            S2400640
      L6 = 8                                                            S2400650
      IF (ISW(11) .EQ. 0) GO TO 110                                     S2400660
      L6 = 12                                                           S2400670
      IF (ISW(11) .EQ. 1) GO TO 110                                     S2400680
      L5 = 16                                                           S2400690
      IF (ISW(11) .EQ. 4) L5 = 20                                       S2400700
      L6 = 24                                                           S2400710
  110 CONTINUE                                                          S2400720
      WRITE (IOTFIL,9005) (LABL4(L,K),L=1,7),(LABL1(L,L1),L=1,5),(LABL2(S2400730
     *L,L2),L=1,2),(LABL3(L+L3),L=1,4),(LABL3(L+L4),L=1,4),Z            S2400740
      LINE = LINE+3                                                     S2400750
      IF (JN .EQ. 2) GO TO 120                                          S2400760
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     WRITE (IOTFIL,9006) (LABL4(L,K),L=1,7),CMAX,XMX,YMX                    S2400770
     LINE = LINE+1                                                          S2400780
 120 WRITE (IOTFIL,9007)                                                    S2400790
     LINE = LINE+2                                                          S2400800
 130 IF (JN .NE. 0) GO TO 140                                               S2400810
     WRITE (IOTFIL,9008) (X(L),L=J1,J2)                                     S2400820
     WRITE (IOTFIL,9009) (LABL4(L,K),L=1,7)                                 S2400830
     LINE = LINE+5                                                          S2400840
     GO TO 160                                                              S2400850
 140 IF (JN .NE. 1) GO TO 150                                               S2400860
     WRITE (IOTFIL,9010) ((LABL4(L,K),L=1,7),M=1,3)                         S2400870
     LINE = LINE+4                                                          S2400880
     GO TO 160                                                              S2400890
 150 WRITE (IOTFIL,9011) ((LABL4(L,K),L=1,7),M=1,2),(LABL3(L+L5),L=1,4)S2400900
    *,(LABL3(L+L6),L=1,4)                                                   S2400910
     LINE = LINE+5                                                          S2400920
 160 RETURN                                                                 S2400930
9001 FORMAT (24H1FOREST SPRAY MODEL *** ,20A4,10H *** DATE ,2(I2,1H/),  S2400940
    *I2,7H, PAGE ,I3/)                                                      S2400950
9002 FORMAT (58X,6HTABLE ,I2,8H (CONT.))                                    S2400960
9003 FORMAT (62X,6HTABLE ,I2)                                               S2400970
9004 FORMAT (////)                                                          S2400980
9005 FORMAT (/40X,4H*-* ,7A2,1H(,3A2,1X,2A2,1H/,3A2,A1,1X,3A2,A1,5H) *-S2400990
   **/40X,3H*-*,8X,15HAT A HEIGHT OF ,F8.4,7H METERS,8X,3H*-*)          S2401000
9006 FORMAT (32X,9H(MAXIMUM ,7A2,1H=,E13.7,6H AT X=,F10.3,4H, Y=,F10.3,S2401010
    *1H))                                                                   S2401020
9007 FORMAT (/)                                                             S2401030
9008 FORMAT (8H  Y AXIS,40X,19H- X AXIS (METERS) -/9H (METERS),9(3X,F9.S2401040
    *2,1X))                                                                 S2401050
9009 FORMAT (39X,2H- ,7A2,2H -/1X,63(2H--))                                 S2401060
9010 FORMAT (46X,22H- DISCRETE RECEPTORS -/3(24H X (METERS)  Y (METERS)S2401070
    * ,7A2)/1X,57(2H--))                                                    S2401080
9011 FORMAT (47X,22H- AREA OF COVERAGE OF ,7A2,2H -/46X,7A2,6X,6HAREA (S2401090
    *,3A2,A1,1X,3A2,A1,1H)/46X,7(2H--),6X,10(2H--)/)                        S2401100
     END                                                                    S2401110
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